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D'APPOLONIA CONSULTING ENGINEERS PITTSBURGH PA  
NATIONAL DAM INSPECTION PROGRAM. QUEMAHONING DAM (NDI ID NUMBER--ETC(U)  
JUL 78

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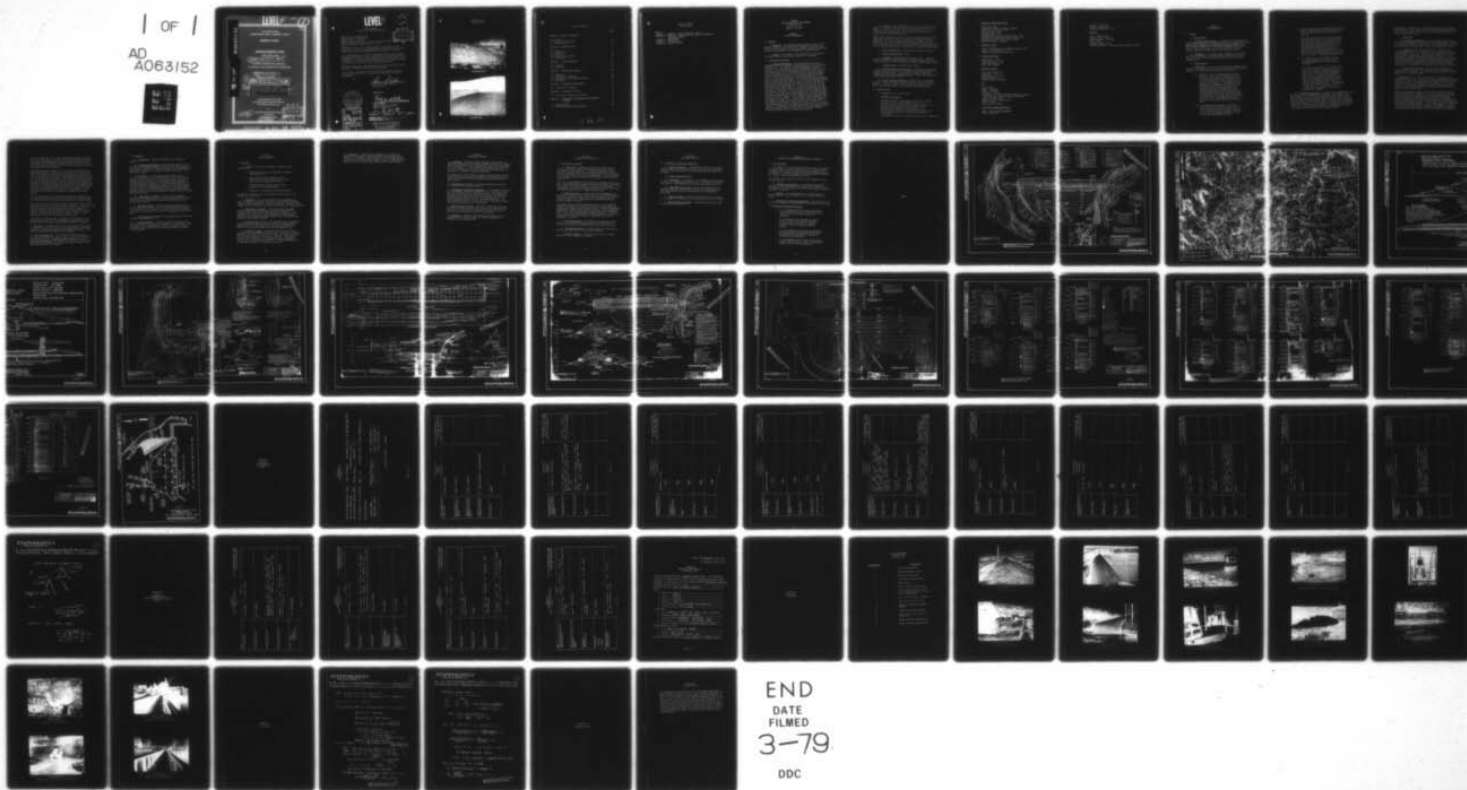
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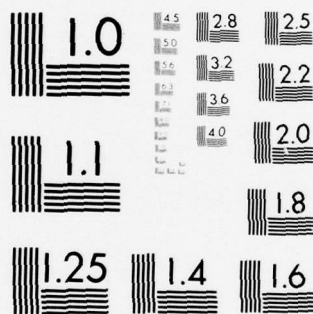
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LEVEL II

1

3 OHIO RIVER BASIN  
QUEMAHONING CREEK, SOMERSET COUNTY

PENNSYLVANIA

2 QUEMAHONING DAM

(NDI I.D.NO: 740)

15 DACW31-78-C-449

PHASE I INSPECTION REPORT  
NATIONAL DAM INSPECTION PROGRAM

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National Dam Inspection Program.  
Quemahoning Dam (NDI ID Number 740), Ohio  
River Basin, Quemahoning Creek, Somerset  
County, Pennsylvania. Phase I Inspection  
Report.

DEPARTMENT OF THE ARMY  
BALTIMORE DISTRICT, CORPS OF ENGINEERS  
BALTIMORE, MARYLAND 21203

BY

1275p D'APPOLONIA CONSULTING ENGINEERS  
10 DUFF ROAD  
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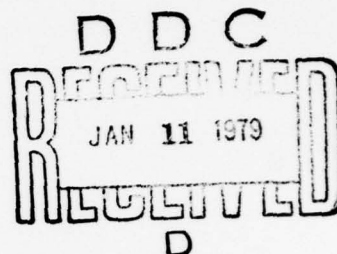
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# LEVEL II

PHASE I REPORT  
NATIONAL DAM INSPECTION PROGRAM

NAME OF DAM: Quemahoning Dam  
STATE LOCATED: Pennsylvania  
COUNTY LOCATED: Somerset  
STREAM: Quemahoning Creek, tributary of Stoney Creek  
DATE OF INSPECTION: (June 8 and 12, 1978)




ASSESSMENT: Based on the evaluation of the conditions as they existed on the dates of inspection and as revealed by visual observations, the condition of Quemahoning Dam is assessed to be good.

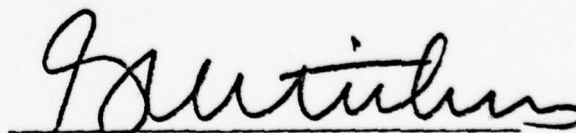
It is recommended that the owner periodically monitor and record the piezometers installed in 1961 to measure the pore pressures within the embankment to aid in future evaluation of the performance of the embankment. It is also recommended that appropriate repairs be made to stop concrete spalling on the spillway channel walls.

The spillway has the recommended capacity to pass the probable maximum flood. Therefore, the spillway is adequate.

It is further recommended that the owner should develop a formal warning system to alert the downstream residents in the event of emergencies.

  
Lawrence D. Andersen, P.E.  
Vice President

APPROVED BY:

  
G. K. WITHERS  
Colonel, Corps of Engineers  
District Engineer

DATE:

31 Jul 78

Contract DACW 31-78-C-0044

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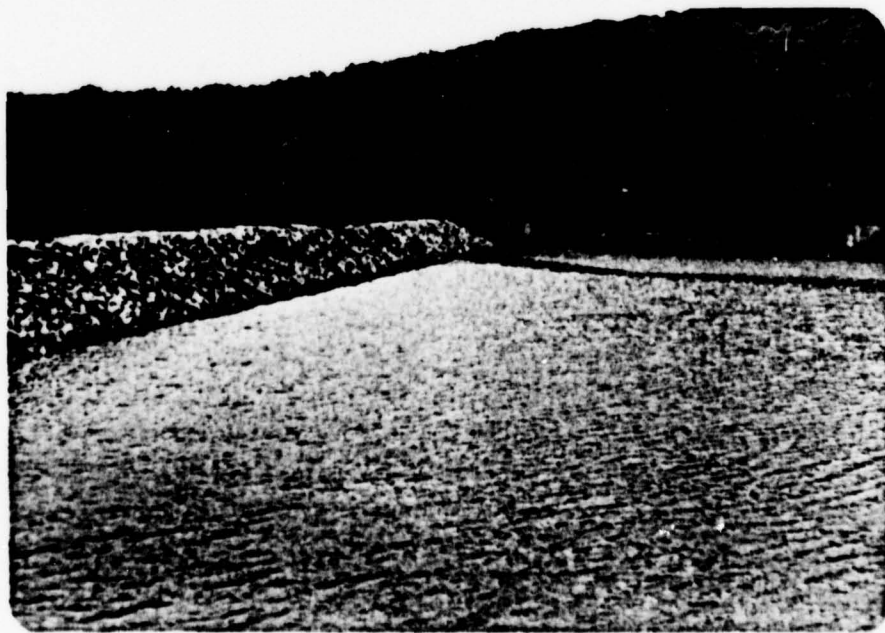
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QUEMAHONING DAM  
JUNE 9, 1978



Downstream Face



Upstream Face

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PHASE I  
NATIONAL DAM INSPECTION PROGRAM  
QUEMAHONING DAM  
NDI I.D. NO. 740  
DER I.D. NO. 56-4

SECTION 1  
PROJECT INFORMATION

1.1 General

a. Authority. The inspection was performed pursuant to the authority granted by The National Dam Inspection Act, Public Law 92-367, to the Secretary of the Army, through the Corps of Engineers, to conduct inspections of dams throughout the United States.

b. Purpose. The purpose of this inspection is to determine if the dam constitutes a hazard to human life or property.

1.2 Description of Project

*↳ The Quemahoning Dam*

a. Dam and Appurtenances. The dam consists of an earth embankment 955 feet long with a maximum height of 100 feet from the downstream toe. The combined primary and emergency spillway is located on the right abutment (looking downstream), (Plate 1). The flow through the spillway discharges over two ogee weir sections. A 185-foot-long section of the ogee weir in line with the axis of the dam discharges directly into the spillway discharge channel. A second 210-foot-long section is oriented perpendicular to the axis of the dam and constitutes a side channel spillway discharging into the same downstream channel. Flow through the discharge channel passes over two ogee weirs and a series of steps to control flow velocity and dissipate energy and then into a pool about 200 feet downstream of the embankment toe. A rock dike along the left side of the discharge channel (Plate 1) protects the embankment during high flows. The outlet works for the dam consist of lake and supply line blow-off facilities. The lake blow-off is controlled by gates located at the intake tower and discharges into a 21-foot-high and 30-foot-wide semicircular diversion tunnel located below the embankment near the left abutment. This diversion tunnel discharges into a concrete stilling basin. A 60-inch supply line located along the left abutment is also controlled by valves at the intake tower. The supply line blow-off is controlled by valves located in a valve house approximately 300 feet downstream from the end of the diversion tunnel. In an emergency, the lake can be drawn down through either the lake or supply line blow-off facilities. The dam impounds 37,000 acre-feet of water at normal pool elevation.

*Section  
P. A)*



b. Location. Quemahoning Dam is located on Quemahoning Creek (Plate 2), about one mile upstream from its confluence with Stoney Creek, two miles south of the towns of Hollsopple and Benson in Somerset County, Pennsylvania. The dam lies on the boundary of Quemahoning and Conemaugh townships.

Stoney Creek, downstream from its confluence with Quemahoning Creek, flows north for about 10 miles and joins the Conemaugh River at Johnstown. The towns of Benson and Hollsopple would be the first impact area of a flood in the event of a failure of Quemahoning Dam. It is estimated that a failure of the dam would also cause significant loss of life and property as far downstream as the City of Johnstown.

c. Size Classification. Large (based on 100-foot height).

d. Hazard Classification. High.

e. Ownership. The Manufacturers Water Company. (Address: Mr. Bruce Barger, Manager, Manufacturers Water Company, Bethlehem Steel Corporation, 119 Walnut Street, Johnstown, Pennsylvania 15901).

f. Purpose of Dam. Industrial water supply.

g. Design and Construction History. The dam was designed and constructed by the engineers of the Manufacturers Water Company of Johnstown, Pennsylvania. Mr. Frederic D. Stearns of Boston, Massachusetts, was the consulting engineer. The dam was constructed in the period from 1909 to 1912.

h. Normal Operating Procedure. The reservoir is maintained at spillway level, Elevation 1627 (USGS Datum). Flow in excess of demand is discharged through the uncontrolled spillways. The dam has no operational feature to affect the flood flow discharge.

### 1.3 Pertinent Data

a. Drainage Area - 94 square miles

b. Discharge at Dam Site

Maximum known flood at dam site - 10,200 cfs (in 1936)

Warm water outlet at pool elevation - N/A

Diversion tunnel low pool outlet at pool elevation - N/A

Diversion tunnel outlet at pool elevation - N/A

Gated spillway capacity at pool elevation - N/A

Gated spillway capacity at maximum pool elevation - N/A

Ungated spillway capacity at maximum pool elevation -  
91,000 cfs

Total spillway capacity at maximum pool elevation - 91,000 cfs



c. Elevation (USGS Datum) (feet)

Top of dam - 1642  
Maximum pool-design surcharge - Unknown  
Full flood control pool - N/A  
Recreation pool - N/A  
Spillway crest - 1627  
Upstream portal invert diversion tunnel - N/A  
Downstream portal invert diversion tunnel - N/A  
Streambed at center line of dam - 1542+  
Maximum tailwater - Unknown

d. Reservoir (feet)

Length of maximum pool - 21,000+ at Elevation 1642  
Length of recreation pool - N/A  
Length of flood control pool - N/A

e. Storage (acre-feet)

Normal pool - 37,000  
Flood control pool - N/A  
Design surcharge - N/A  
Top of dam - 52,700

f. Reservoir Surface

Top of dam - 1065 acres  
Maximum pool - N/A  
Flood control pool - N/A  
Recreation pool - N/A  
Spillway crest - 845 acres

g. Dam

Type - Earth  
Length - 955+ feet  
Height - 100 feet  
Top width - 20 feet  
Side slopes - 3:1 above Elevation 1615 and 4:1 below  
Elevation 1615, both upstream and downstream  
Zoning - Hydraulic fill  
Impervious core - Hydraulic fill  
Cutoff - Partial  
Grout curtain - Partial

h. Diversion and Regulating Tunnel

Type - Tunnel through embankment  
Length - 400+ feet

Closure - Sluice gate  
Access - Intake tower  
Regulating facilities - Yes

i. Spillway

Type - Concrete ogee  
Length of weir - 385 feet  
Crest elevation - 1627 feet  
Gates - None  
Upstream channel - lake  
Downstream channel - Variable width rectangular channel

## SECTION 2 ENGINEERING DATA

### 2.1 Design

#### a. Data Available

(1) Hydrology and Hydraulics. A report by the Commonwealth of Pennsylvania, Department of Environmental Resources (PennDER) entitled, Report Upon the Application of Manufacturers Water Company, dated July 17, 1961, summarizes the most recent hydrologic and hydraulic data available for the dam. The report includes the capacity criteria used for the modification of the spillway in 1961.

(2) Embankment. No original design information is available. The available information includes design drawings, boring logs, engineer's report, and construction specifications for the 1961 modifications.

#### b. Design Features

(1) Embankment. A review of the available information for the dam shows the following main features of the project as originally designed. The modifications are discussed in Section 2.2.

- (a) As built, the dam is an hydraulically-filled embankment with a partial concrete cutoff wall (Plate 3). The upstream and downstream toes of the embankment were built of material excavated from the center of the dam site by usual construction techniques. The remainder of the embankment was hydraulically filled with the material sluiced from the abutments. The sluiced material was discharged along the upstream and downstream sides of the center of the embankment toward a pond maintained along the center line of the dam. This construction technique allowed the finest material to settle at the center of the embankment and coarser material to each side of the center line of the dam.
- (b) The embankment was designed to have three to one (horizontal to vertical) slopes from crest level (Elevation 1642) down to a point 27 feet below the crest (Elevation 1615) and four to one slopes below this point, on both the upstream and downstream faces.

- (c) A Cambria Steel Company report dated February 20, 1913, includes the following description of the extent of concrete cutoff wall and foundation grouting:

"A concrete cut-off wall was then constructed along the center line of the dam and carried well into the underlying rock, except at the east end, where a good clay deposit of considerable thickness overlies the rock. The rock immediately beneath the core wall is grouted with Portland cement grout for a depth of 10 feet through drill holes on 10 foot centers, the grout being forced into the rock under a pressure of 20 pounds per square inch."

- (d) In a 1918 report, Mr. Frederic P. Stearns, the consulting engineer, described the foundation treatment on the east abutment as follows:

"At the site of the dam on the easterly hillside, there was above the rock a deposit of clayey earth having a maximum thickness of more than 40 feet and an average thickness of about 30 feet. This earth was proved by tests to be substantially water-tight, and hence the only part removed before building the dam and embankment was that near the surface, which contained more or less roots and had been affected by frost. The building of this portion of the dam on an earth instead of a rock foundation did not cause any important leakage."

(2) Appurtenant Structures. The appurtenant structures for the dam consist of the spillway and outlet works. The spillway structures consist of an L-shaped ogee overflow section (Plates 4 and 5), a side channel spillway, spillway discharge channel, and a plunge pool at the end of the discharge channel. The ogee weir, which has a total crest length of 395 feet, consists of a 185-foot section along the axis of the dam and a 210-foot section perpendicular to the axis of the dam. The crest of the spillway is at Elevation 1627. The long weir section constitutes a side channel spillway.



As described in Section 1.2, a diversion tunnel used during construction serves as a lake blow-off facility through the gates controlled from the intake tower. The lake can also be discharged through the 48-inch supply line blow-off.

c. Design Data

(1) Hydrology and Hydraulics. The 1961 PennDER report states that before enlargement of the spillway, the spillway design discharge was 29,800 cubic feet per second (cfs). After enlargement, the spillway is capable of passing 45,000 cfs with a freeboard of 5.6 feet.

(2) Embankment. No engineering data are available on the original design of the dam. However, as part of the design to raise the embankment in 1961, the stability of the embankment was studied by E. D'Appolonia Associates, of Pittsburgh, Pennsylvania. The investigation included subsurface investigation, laboratory testing, and stability analyses. The stability of the embankment was analyzed for rapid drawdown and steady-state conditions, and the minimum factor of safety was reported to be 1.58 for the higher embankment cross section. The extent of modifications is discussed in Section 2.2.

(3) Appurtenant Structures. The 1961 design calculations were available for review. They indicate that the redesign of the spillway was in conformance with the state spillway capacity criteria applicable at the time of design.

2.2 Construction. Very limited information is available on the construction of the dam. It includes various photographs taken during construction and a brief description of the construction in the post-construction report. A state report dated January 31, 1918, notes, "This is a most excellent example of good design and construction." Other accounts from post-construction reports also indicate that the dam was constructed with care.

Available information indicates that the dam has undergone several modifications after its completion. The most recent and most extensive modification was undertaken in 1961 and included raising the crest of the dam with additional earth fill and enlarging and raising the spillway to increase storage capacity. The modifications prior to 1961 were mainly related to erosion problems encountered in the spillway discharge channel. In 1920, eight years after completion, the spillway discharge channel was rebuilt and extended. In 1933, a state construction permit was issued for rebuilding and repairing the spillway discharge channel and for constructing a new retaining



wall along the right side of the channel and new paving at the end of the existing channel. However, following the flood in 1936, the 1933 repairs were damaged and additional channel construction was undertaken. The 1936 repairs included the construction of a 220-foot concrete-paved extension to the discharge channel and repairing the paving in the upper portions.

Available information indicates that the only modification made on the embankment prior to 1961 was the construction of a cutoff wall on the left side of the spillway and grouting the left abutment in 1933. The cutoff wall was built to stop seepage observed on the left side of the spillway. The work included driving two parallel rows of sheet piling along the center of the crest extending 18 feet from the left side of the spillway towards the middle of the embankment, excavating the material between the sheet piles and backfilling with concrete. It was reported that the concrete wall was keyed 18 inches into the rock, which was about 20 feet below the crest of the dam. In 1933, the left abutment was grouted to stop seepage. The holes were drilled to a depth of over 100 feet, pressure tested, and grouted.

The 1961 enlargement of the dam and the spillway was undertaken for the purpose of increasing the storage capacity from 31,800 acre-feet at Elevation 1620 to the present 37,000 acre-feet at Elevation 1627.

The crest of the dam was raised by 9 feet to Elevation 1642. Plate 6 illustrates the details of the embankment enlargement. The crest of the existing spillway was raised from Elevation 1620 to Elevation 1627, and the 210-foot-long side channel spillway was constructed to increase the flood discharge capacity of the reservoir to a design value of 45,000 cfs with 5.6 feet of freeboard. Plates 4 and 5 illustrate the extent of the spillway modifications.

In conjunction with this work, a subsurface investigation was conducted and the stability of the embankment was reevaluated. The boring locations and boring logs are shown in Plates 7 through 10.

2.3 Operation. Operating records of the dam include daily records of pool level, water depth over the four seepage weirs, daily precipitation, average air temperature, and weather conditions. Operating records for the dam are available from 1915.

2.4 Other Investigations. The available information includes numerous state inspection reports. The most recent state inspection was conducted in 1976. Feasibility Study, January 1961, and Stability Investigation, May 1961, were prepared by E. D'Appolonia Associates for Bethlehem Steel Company, the parent company of the owner, Manufacturers Water Company.

## 2.5 Evaluation

a. Availability. Available information was provided by PennDER.

(1) Hydrology and Hydraulics. The reported results of the hydrology and hydraulic analysis indicate that the 1961 redesign of the spillway followed the criteria set forth by the Commonwealth of Pennsylvania, Department of Forests and Waters, applicable at the time of the design.

(2) Embankment. No quantitative geotechnical data are available on the design of the embankment. In view of the age of the dam, completed in 1912, the design approach and construction techniques are not likely to be in conformance with currently accepted engineering practice. The dam was reinvestigated in 1961 in conjunction with an enlargement project and this investigation included subsurface exploration, laboratory testing, and stability analysis. Review of the geotechnical aspects of the 1961 investigation indicates that this work generally followed currently accepted engineering practice.

(3) Appurtenant Structures. Review of design drawings indicates that as modified in 1961, there are no significant design deficiencies that should affect the overall performance of the appurtenant structures.

c. Operating Records. Operating records are maintained by the dam tender and copies of the records are available at the office of the owner and at the dam site. In the 1936 flood, the maximum pool level was Elevation 1625.4, which is considered to be the record high.

d. Post-Construction Changes. Various modifications made were discussed in Section 2.2.

e. Seismic Stability. The dam is located in Seismic Zone 1 and static stability of the dam is considered to be adequate. Therefore, based on the recommended criteria for evaluation of seismic stability of dams, the structure is assumed to present no hazard from earthquakes.

SECTION 3  
VISUAL INSPECTION

3.1 Findings

a. General. The on-site inspection of Quemahoning Dam consisted of:

1. Visual inspection of the embankment, abutments, and embankment toe.
2. Visual examination of spillway and its components, the downstream end of the outlet pipe, and other appurtenant features.
3. Observation factors affecting the runoff potential of the drainage basin.
4. Evaluation of downstream area hazard potential.

The specific observations are illustrated in Plate 11 and in the photographs in Appendix C.

b. Embankment. The overall condition of the embankment is good. No signs of significant distress, such as cracks, subsidence bulging, uncontrolled seeps, or boils were observed. However, it was observed that the piezometers installed in 1961 were not being monitored.

c. Appurtenant Structures. The spillway crest, discharge channel, plunge pool, and diversion tunnel were examined for deterioration of the concrete and other signs of distress. These structures were found to be in good condition, except concrete spalling in the spillway discharge channel walls. Minor seeps were observed in the diversion tunnel.

d. Reservoir Area. Review of the regional geology (Appendix E) indicates that the shorelines are not likely to be susceptible to massive landslides which would affect the storage volume of the reservoir or cause overtopping of the dam by displaced water.

e. Downstream Channel. Quemahoning Creek flows into Stoney Creek about one mile downstream from the dam. The towns of Holsopple and Benson, two miles north of the dam along Stoney Creek, would be the first impact areas of a flood in the event of a dam failure. Sketches of two bridges in this reach are included in Appendix A and are shown in photographs in Appendix C. Further description of the downstream condition is included in Section 1.

3.2 Evaluation. In general, the condition of the dam is considered to be very good. Some significant concrete spalling was observed in the spillway discharge channel. The spalling does not appear to have caused structural damage. However, repair measures should be taken to avoid further deterioration of the concrete.



## SECTION 4 OPERATIONAL FEATURES

4.1 Procedures. The water company personnel reported that the operational procedures include daily readings of pool level, seepage weirs, precipitation, and air temperature. Supply water discharge is also recorded. The only operational procedures of the dam which may affect the safety of the dam are the blow-off facilities, in case they are required to lower the reservoir.

The maintenance of outlet works, clearing of debris from the spillway as required, and continued inspection of the facilities by the dam tender are the principal maintenance operations which would affect safety.

4.2 Maintenance of the Dam. The overall maintenance condition of the dam is found to be satisfactory.

4.3 Maintenance of Operating Facilities. The maintenance condition of the operating facilities is satisfactory. All the flow control gates can be mechanically or manually operated. The operation of the lake blow-off gate was not observed. However, the dam tender explained the procedure required to open this gate and all the related equipment appeared to be in functional condition. The other drawdown facility of the dam, the supply line blow-off valve, was operated and observed to be functional.

4.4 Warning System in Effect. There is no formal warning system in effect. However, the dam tender resides at the site and telephone and radio communication facilities are available with the company office and security personnel in Johnstown.

4.5 Evaluation. The dam is satisfactorily maintained and it is considered to be accessible under all weather conditions for inspection and emergency action.



SECTION 5  
HYDRAULICS AND HYDROLOGY

5.1 Evaluation of Features

a. Design Data. Quemahoning Dam has a watershed area of 94 square miles and impounds a reservoir with a surface area of 845 acres at normal pool level. A 395-foot-long ogee overflow section at Elevation 1627, 15 feet below the dam crest, constitutes the flood discharge facility for the impoundment. The full capacity of the spillway (with no freeboard) was computed to be 91,000 cfs (Appendix D).

There are six impoundments located within the drainage basin of the dam. Lake Gloria and Lake Stoughton are the two largest impoundments, with storage capacities reported to be 264 and 233 acre-feet, respectively. These are very small compared to the 15,700 acre-feet surcharge storage capacity of Quemahoning Reservoir.

b. Experience Data. As previously stated, Quemahoning Dam is classified to be a "large" size dam in the "high" hazard category. Under the recommended criteria for evaluating emergency spillway discharge capacity, such impoundments are required to pass the probable maximum flood (PMF).

The adequacy of the spillway was analyzed based on the simplified procedure developed by the Baltimore District, Corps of Engineers conservatively neglecting the storage effect of upstream impoundments (Appendix D). Based on this analysis procedure, it was determined that the PMF inflow hydrograph would have a peak flow of 64,000 cfs, and a total volume of approximately 130,000 acre-feet. It was calculated that the spillway can pass the peak PMF inflow with a freeboard of 4.0 feet.

c. Visual Observations. On the date of inspection, no conditions were observed which would indicate that the spillway of the dam could not operate satisfactorily in the event of a flood.

d. Overtopping Potential. As stated above, the spillway can pass the peak PMF without the dam being overtopped.

e. Spillway Adequacy. The spillway can pass the peak PMF; therefore, it is classified as adequate.

SECTION 6  
STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability

a. Visual Observations. As discussed in Section 3, the field observations did not reveal any signs of distress that would significantly affect the stability of the dam and none were reported in the past.

b. Design Construction Data

(1) Embankment. The stability of the embankment was reanalyzed in 1961 by E. D'Appolonia Associates, Inc., and was reported to be satisfactory. The minimum factor of safety was stated to be 1.58.

(2) Appurtenant Structures. Review of the design drawings indicates that there are no apparent structural deficiencies that would significantly affect the performance of the appurtenant structures.

c. Operating Records. The structural stability of the dam is not considered to be affected by the operational features of the dam.

d. Post-Construction Changes. The modifications made in 1961 are performing satisfactorily.

SECTION 7  
ASSESSMENT AND RECOMMENDATIONS/REMEDIAL MEASURES

7.1 Dam Assessment

a. Safety. The visual observations and review of available information indicate that Quemahoning Dam is in good condition. It appears that the dam was constructed with reasonable care and the design of the 1961 enlargement of the dam generally followed the currently accepted engineering practices.

The capacity of the spillway was found to be "adequate" to pass the peak PMF flow.

b. Adequacy of Information. The available information in conjunction with visual observations and previous experience of the inspectors are considered to be sufficient to make a reasonable assessment of the dam.

c. Urgency. The recommendations listed below should be implemented as soon as practicable or on a continued basis, as noted.

d. Necessity for Further Investigation. The condition of the dam is not considered to require further investigation at this time.

7.2 Recommendations/Remedial Measures

1. It is recommended that the owner should locate the piezometers installed in 1961 and monitor and record the water levels within the embankment.
2. It is recommended that appropriate repairs should be made to stop concrete spalling at various locations along the spillway discharge channel to prevent structural damage.
3. It is recommended that the dam and appurtenant structures should be inspected regularly and any unusual condition should be reported to the appropriate authorities.
4. It is recommended that the owner should develop a formal warning system to alert the downstream residents in the event of emergencies.

PLATES

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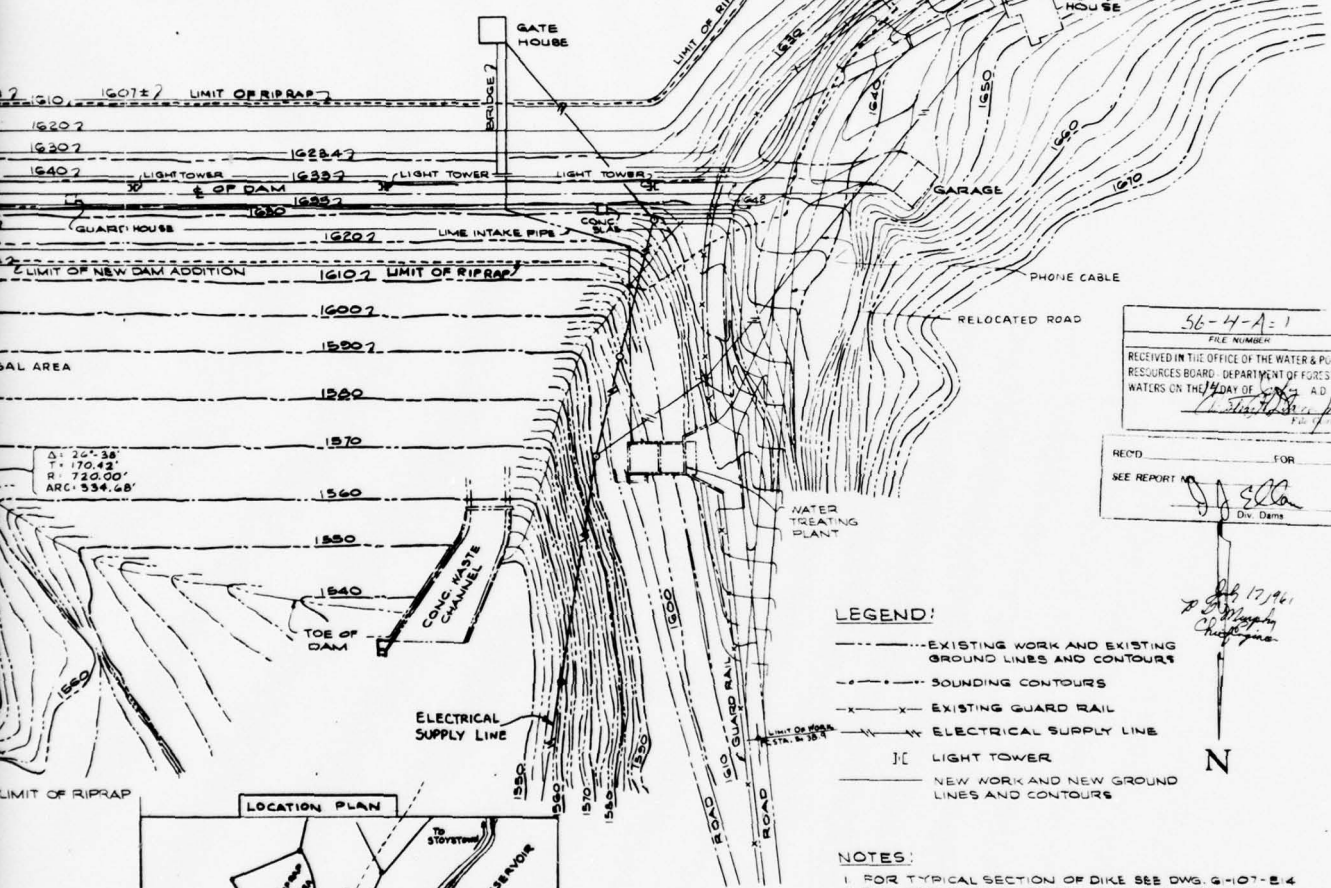
# DRAWING INDEX

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61-107-E26	NEW RETAINING WALL - EAST SIDE OF SIDE CHANNEL SPILLWAY - SHEET 2 CONCRETE DESIGN
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61-107-E28	ALTERATIONS AND ADDITIONS TO EXISTING SPILLWAY AND WEST SPILLWAY ABUTMENT - CONCRETE DESIGN
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DRAWING	TITLE
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61-107-E4	PLAN AND LOCATION OF BORINGS AT EXISTING DAM AND SPILLWAY
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61-107-E35	EXCAVATION AND COPPER DAM SECTIONS AND DETAILS - SHEET 2

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QUEMAHONING RESERVOIR

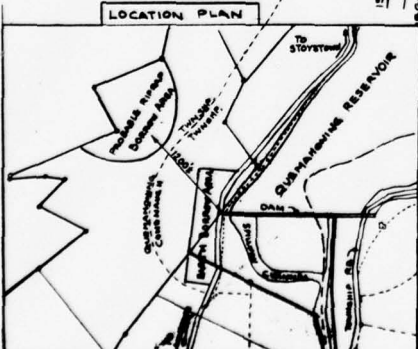
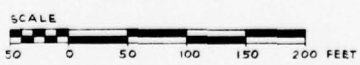


## LEGEND:

- EXISTING WORK AND EXISTING GROUND LINES AND CONTOURS
- SOUNDING CONTOURS
- x-x- EXISTING GUARD RAIL
- x-x- ELECTRICAL SUPPLY LINE
- LT LIGHT TOWER
- NEW WORK AND NEW GROUND LINES AND CONTOURS

## NOTES:

1. FOR TYPICAL SECTION OF DIKE SEE DWG. 61-107-E4
2. FOR GEOMETRY AND DETAILS OF NEW SPILLWAY SEE DWG. 61-107-E13
3. FOR DETAILS OF NEW DAM ADDITION AND FOR GEOMETRY OF ROAD CENTERLINE SEE DWG. 61-107-E15



E. D'APPOLONIA ASSOCIATES CONSULTING ENGINEERS PITTSBURGH, PENNSYLVANIA		ENLARGEMENT OF QUEMAHONING RESERVOIR - GENERAL SITE PLAN	
BETHLEHEM STEEL CO. BETHLEHEM, PA.	DRAWN BY FKI CHECKED BY WES APPROVED BY S	DATE 7-10-61 7-12-61	SCALE 1"=60' DRAWING NO. 61-107-E12

PLATE 1

**D'APPOLONIA**

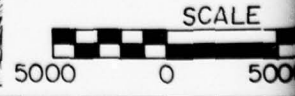
DRAWN BY	D.J.D.	CHECKED BY	BE	7-5-78	DRAWING NUMBER	78	1-B63
	6-24-78	APPROVED BY	JP	7-5-78			



REFERENCE:

USGS, 15', WINDBER PA QUADRANGLE  
DATED: 1914 SCALE - 1:5280

USGS, 15', SOMERSET PA QUADRANGLE  
DATED: 1913 SCALE - 1:5280



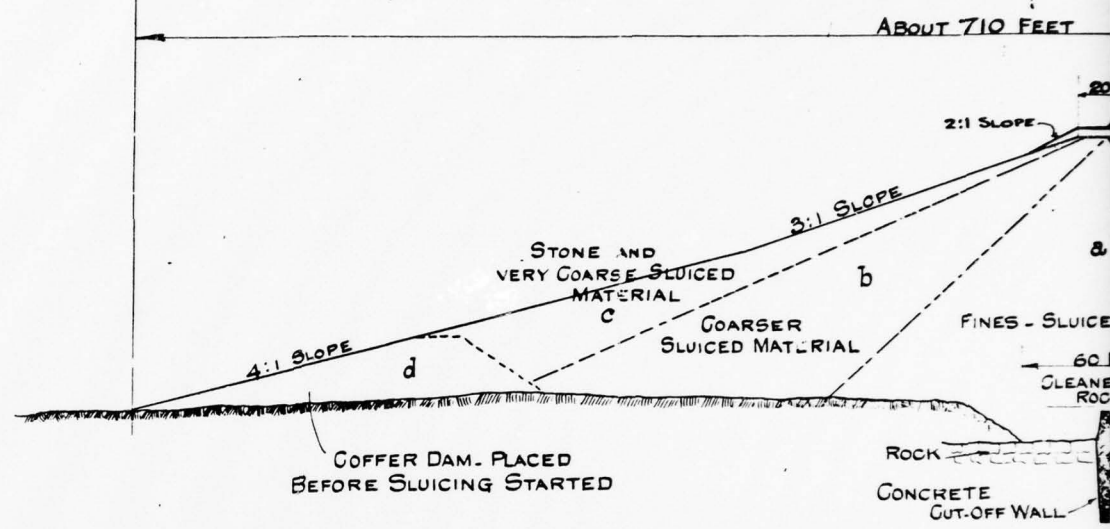




DRAWN BY CJB 7-5-78  
 CHECKED BY BE 7-5-78  
 APPROVED BY SHP 7-5-78  
 DRAWING 78- -B 71  
 NUMBER

SS902'S

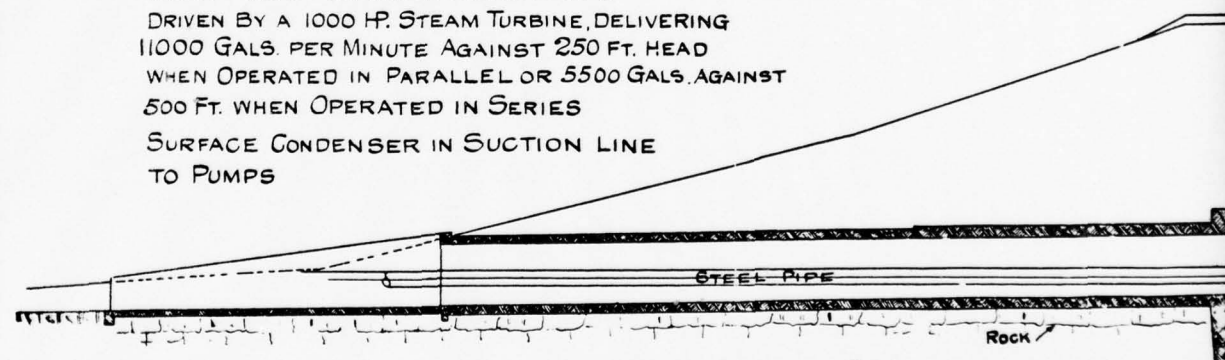
PIPE LINE TO WORKS - 14 MILES LONG  
 STEEL PIPE - 5'6" DIAM.  
 TOTAL WEIGHT OF PIPE - 13000 TONS  
 CROSSES STONYCREEK RIVER 13 TIMES  
 PASSES THROUGH FIVE TUNNELS AGGREGATING 9000 FT IN  
 DAILY FLOW THROUGH PIPE - 75,000,000 TO 90,000,000 G



SLUICING PLANT

1350 HP. WATER TUBE BOILERS  
 TWO 14" TWO-STAGE CENTRIFUGAL PUMPS  
 DRIVEN BY A 1000 HP. STEAM TURBINE, DELIVERING  
 11000 GALS. PER MINUTE AGAINST 250 FT. HEAD  
 WHEN OPERATED IN PARALLEL OR 5500 GALS. AGAINST  
 500 FT. WHEN OPERATED IN SERIES  
 SURFACE CONDENSER IN SUCTION LINE  
 TO PUMPS

ALL SEAMS IN  
 GROUTED TO  
 50 TO 70



CONCRETE CONDUIT 30 FT WIDE 20 FT HIGH, FOR P  
 UPPER END AFTERWARD CLOSED BY  
 13250 CU. YDS

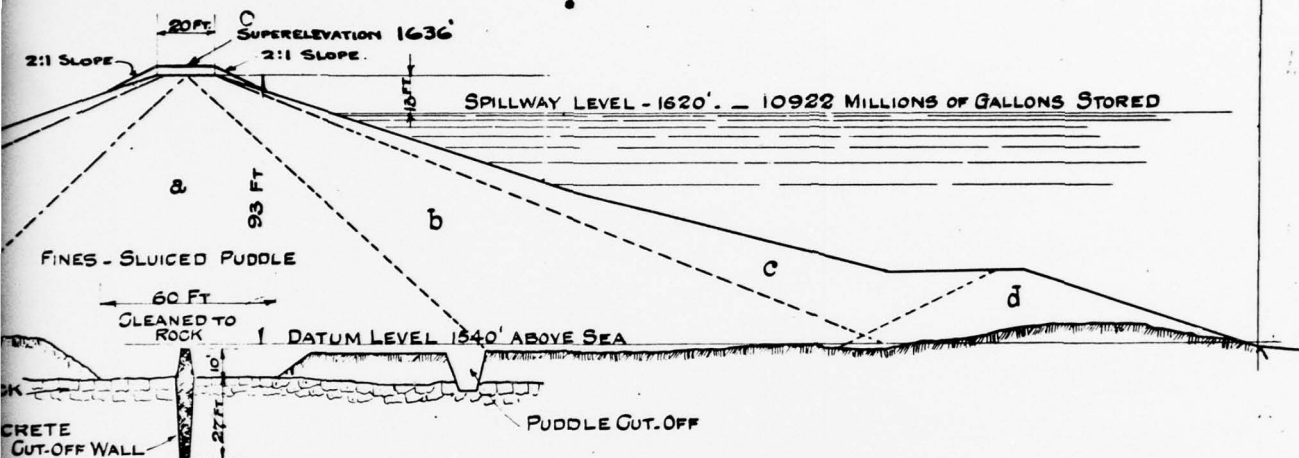
— CAMBRIA S  
 QUEMAHONING  
 S



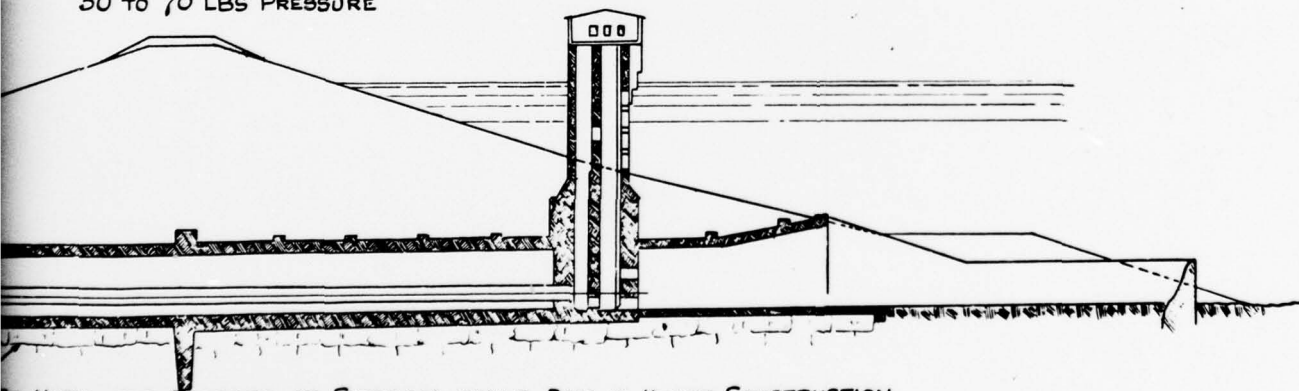
NG 9000 FT IN LENGTH  
90,000,000 GALS.

CATCHMENT AREA - 92 SQ. MILES  
FLOODED AREA - 900 ACRES  
LENGTH OF DAM AT TOP. 950 FEET  
WIDTH OF SPILLWAY. 250 FEET  
MAXIMUM CALCULATED FLOW OVER SPILLWAY - 11,800,000,000 GALS.  
PER 24 HOURS  
MATERIAL IN DAM - 600,000 CU. YDS.

UT 710 FEET



ALL SEAMS IN CUT-OFF TRENCH  
GROUTED TO REFUSAL UNDER  
50 TO 70 LBS PRESSURE



10 FT HIGH, FOR PASSAGE OF STREAM WHILE DAM IS UNDER CONSTRUCTION  
GATE CLOSED BY GATE HOUSE AND PIPE LAID THROUGH IT.  
13,250 CU. YDS CONCRETE IN CONDUCT.

CAMBRIA STEEL CO —  
MAHONING RESERVOIR  
SCALE 1" = 40 FT.

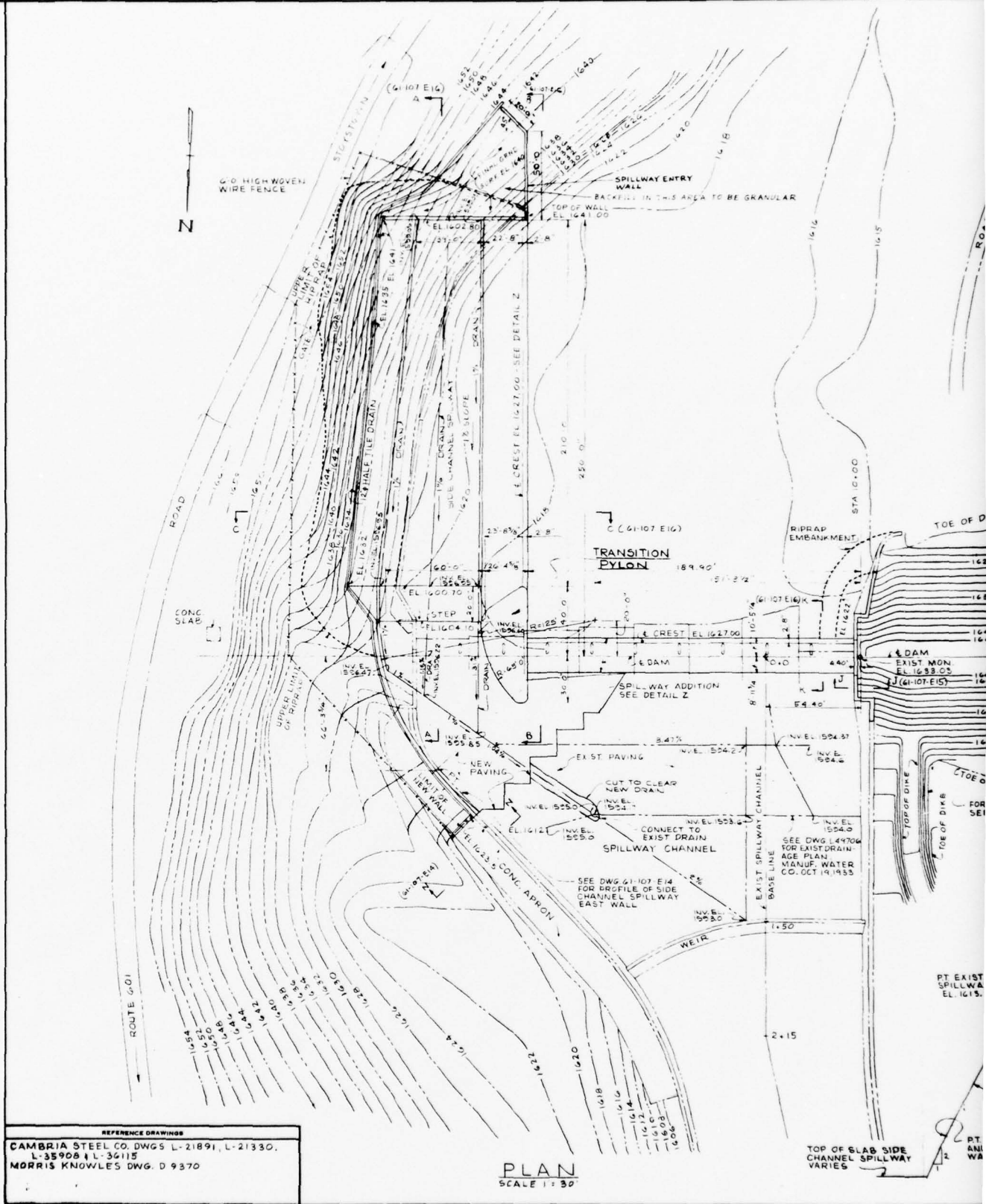
S. 20635  
Mo. 11 DAY - 1911

PLATE 3

D'APPOLONIA

2

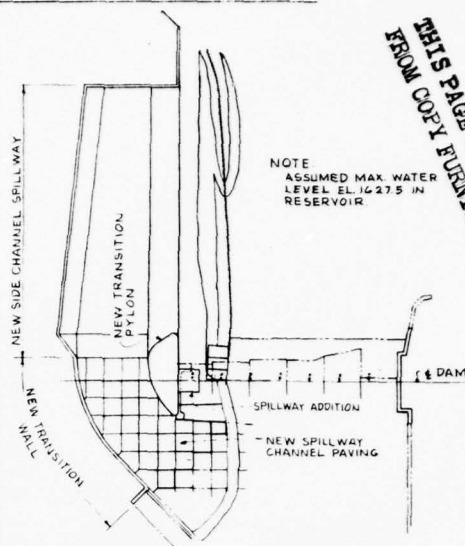
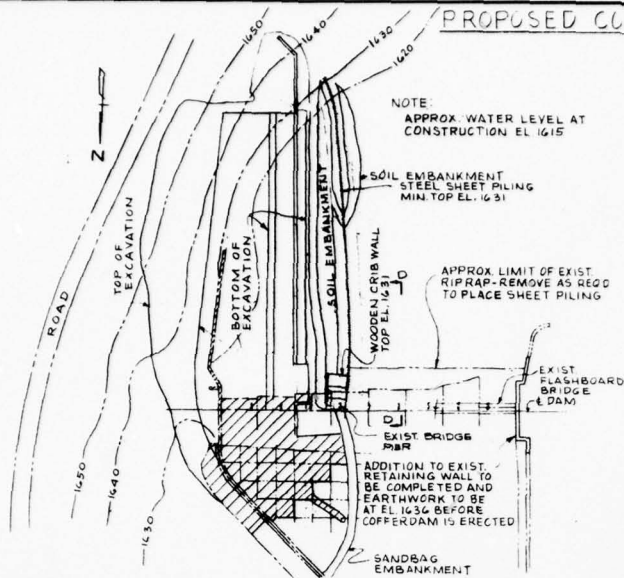
DRAWN BY G.J.G. CHECKED BY 135 7-5-78 DRAWING NUMBER 78 4-B64  
 BY 6-26-78 APPROVED BY JAP 7-5-78



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# PROPOSED CONSTRUCTION SEQUENCE

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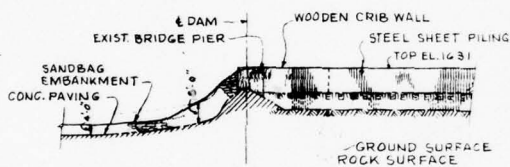


1. REMOVE EXIST. FLASHBOARD BRIDGE - EXIST. ELECTRICAL WIRING ON BRIDGE TO BE REMOVED BY CONTRACTOR
2. ERECT WOODEN CRIB WALL FOR DETAILS SEE DWG 61-107-E21
3. DRIVE SHEET PILING DWG 61-107-E21
4. PLACE SANDBAG EMBANKMENT
5. REMOVE EXIST. SPILLWAY CONCRETE SHOWN
6. EXCAVATE FOR NEW SPILLWAY AND PLACE EXCAVATED SOIL AND ROCK IN TEMPORARY EMBANKMENTS SURROUNDING SHEET PILING AS SHOWN. ROCK GROUTING (DWG 61-107-E20) WITHIN 50' OF EXCAVATED AREA MUST BE COMPLETED BEFORE ROCK EXCAVATION IS BEGUN.

1. DEWATER AS REQUIRED
2. ERECT TRANSITION PYLON PORTION OF SPILLWAY ADDITION
3. ERECT NEW SIDE CHANNEL SPILLWAY, NEW TRANSITION WALL, SPILLWAY PAVING AND DRAINING
4. PLACE HALF TILE DRAIN AND RIPRAP ABOVE EAST WALL OF NEW SIDE CHANNEL SPILLWAY
5. ERECT WIRE FENCE AROUND SIDE CHANNEL SPILLWAY
6. SEED REGRADED AREA BEHIND NEW TRANSITION WALL

## PHASE 1

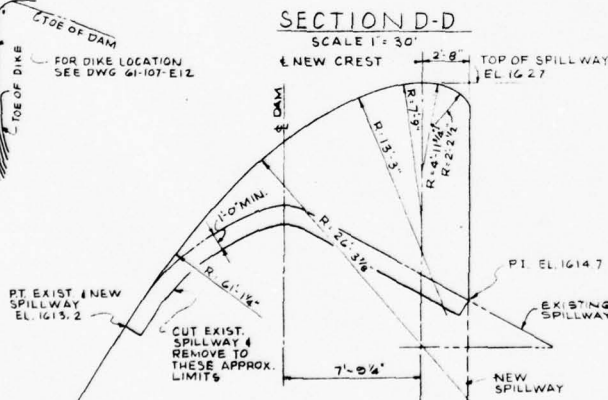
FOR CONTINUATION OF DAM SEE DWG 61-107-E15



## SECTION D-D

SCALE 1" = 30'

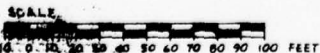
NEW CREST TOP OF SPILLWAY EL 1627



## DETAIL Z - SPILLWAY CROSS SECTION

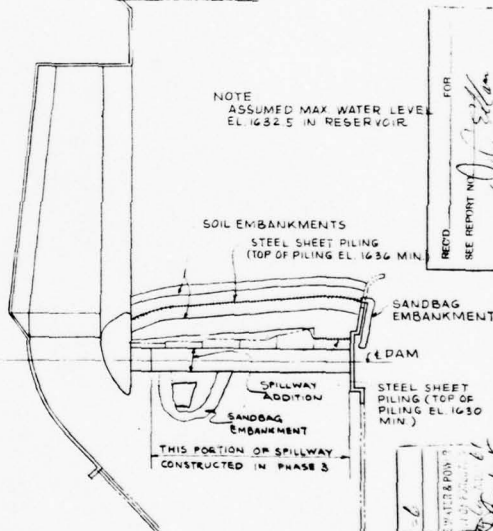
SCALE 1/4" = 1'-0"

NOTE: GEOMETRY - USE FOR ADDITION TO EXISTING SPILLWAY AND NEW SPILLWAY



## PHASE 2

NOTE ASSUMED MAX. WATER LEVEL EL 1632.5 IN RESERVOIR



1. REMOVE STEEL SHEET PILING, TEMPORARY EMBANKMENTS, WOODEN CRIB WALL AND SANDBAG EMBANKMENT FROM POSITION SHOWN IN PHASE 1
2. REPLACE PILING AND TEMPORARY EMBANKMENTS AS SHOWN. REUSE EXISTING PILING AND TEMPORARY EMBANKMENT MATERIAL FROM PHASE 1
3. DEWATER AROUND EXISTING SPILLWAY
4. REMOVE EXISTING BRIDGE PIERS AND ADD NEW SPILLWAY CREST
5. REMOVE STEEL SHEET PILING AND TEMPORARY EMBANKMENTS
6. PLACE RIPRAP EMBANKMENT AT WEST END OF EXIST SPILLWAY

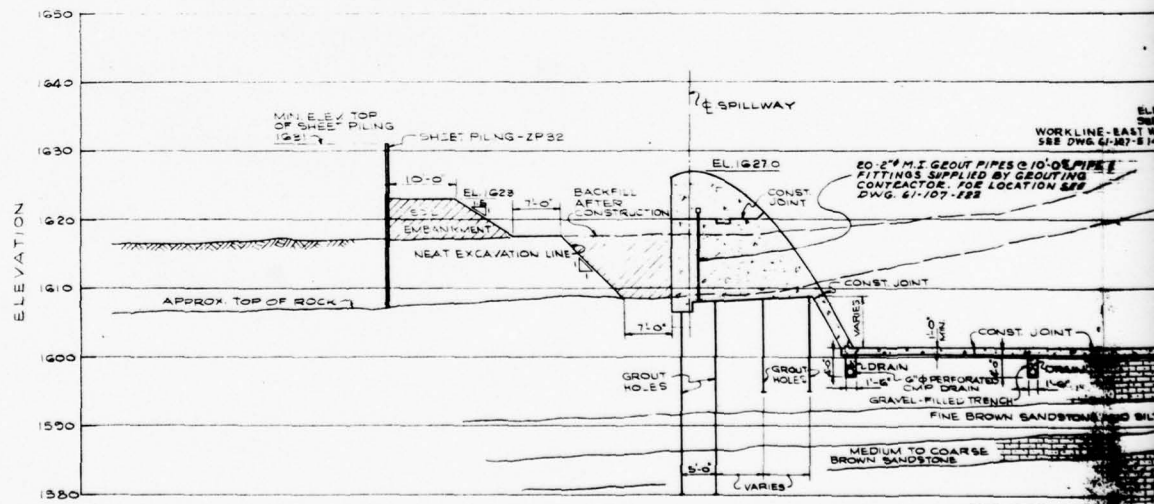
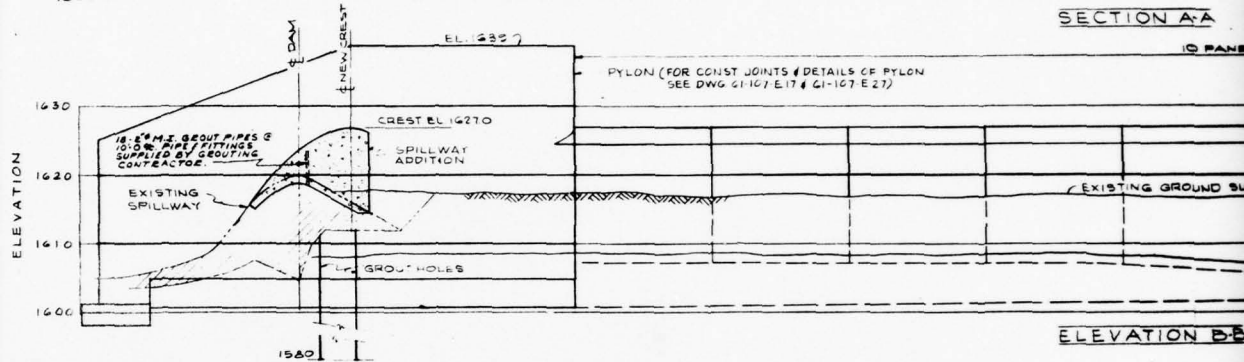
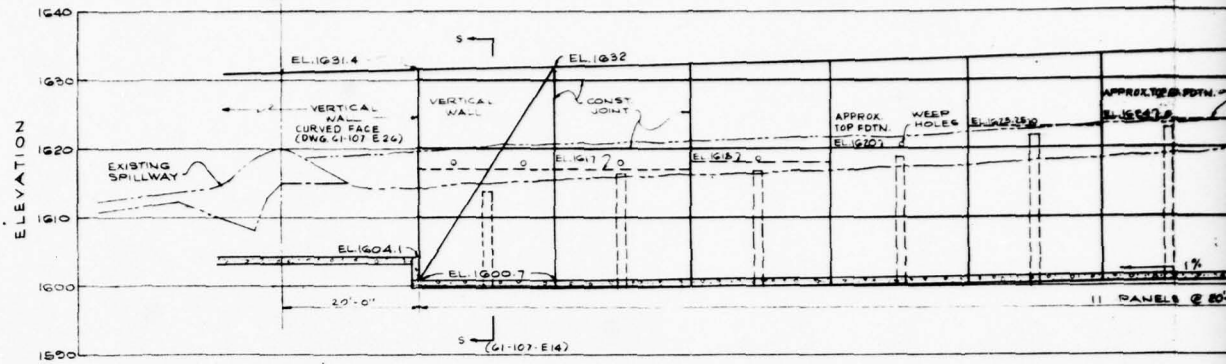
## PHASE 3

E. D'APPOLONIA ASSOCIATES CONSULTING ENGINEERS PITTSBURGH 21, PENNSYLVANIA		ENLARGEMENT OF QUEMANOHING RESERVOIR - GENERAL ARRANGEMENT OF NEW AND EXISTING SPILLWAY AND SPILLWAY CHANNEL - SHEET 3	
DRAWN BY	SL	6-25-61	SCALE: 1" = 30'
CHECKED BY	WES	7-10-61	DATE: 61-107-E15
APPROVED BY	B		

PLATE 4

D'APPOLONIA

DRAWN BY G.J.G. CHECKED BY JSE 7-5-78 DRAWING 78 1-B65  
 6-23-78 APPROVED BY JAP 7-5-78 NUMBER

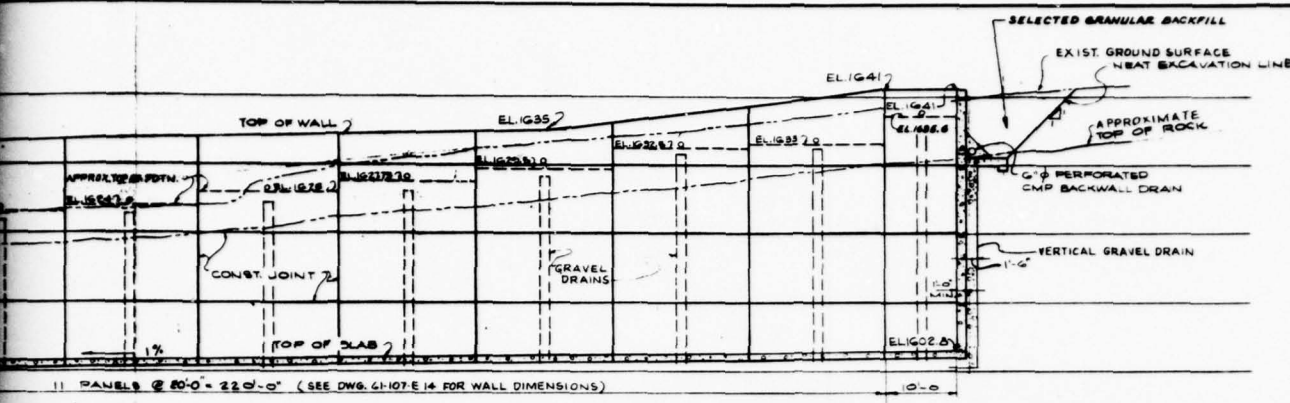


REFERENCE DRAWINGS

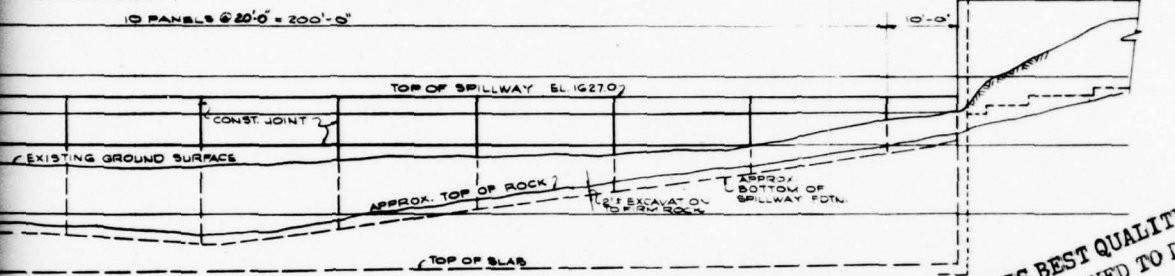
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SECTION C



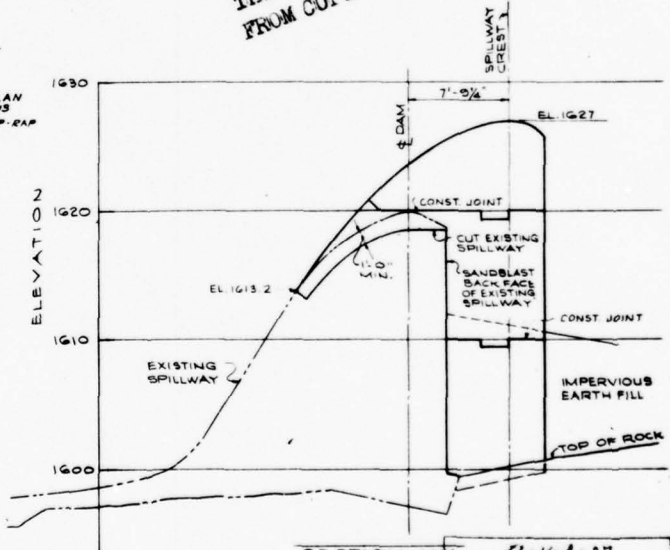
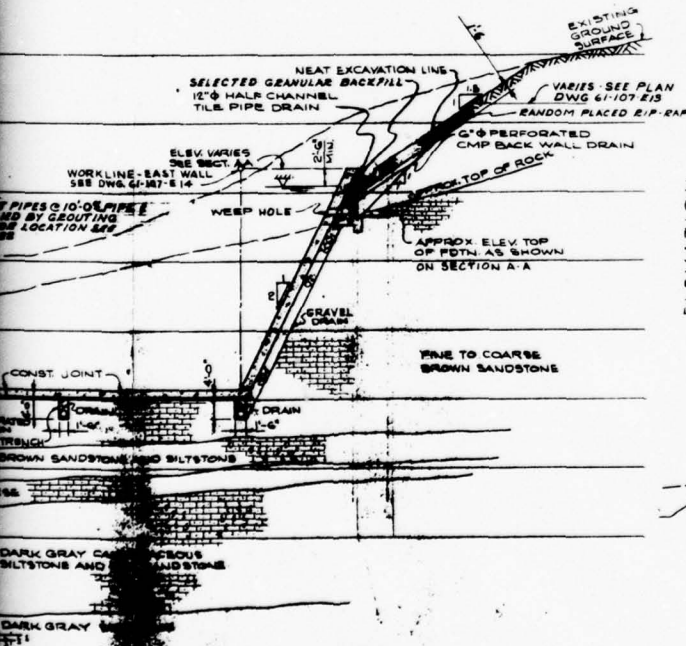


**SECTION A-A**

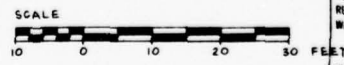


**ELEVATION B-B**

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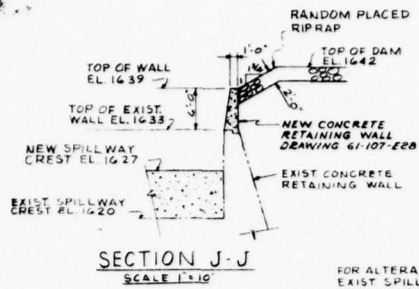
**SECTION K-K** 58-4-A-37



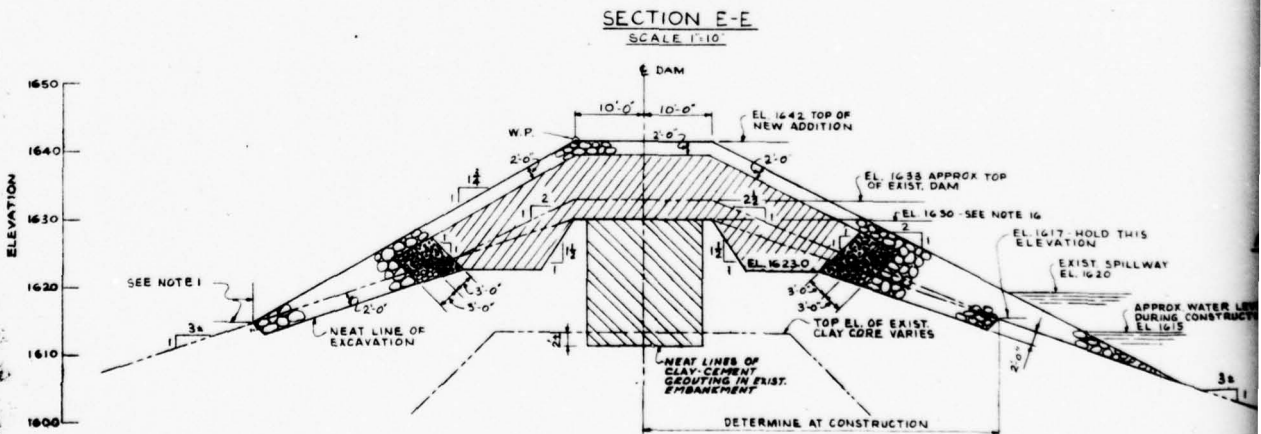
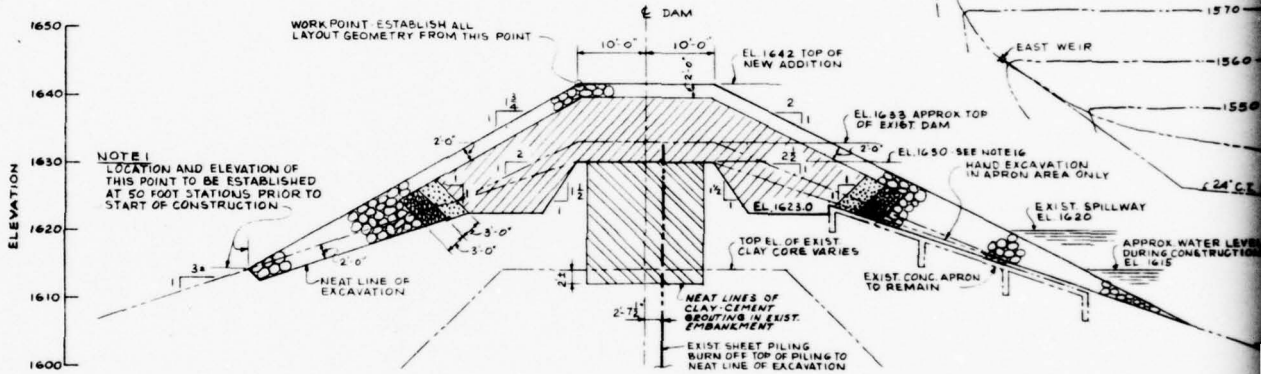
NOTES:  
FOR PLAN, SEE DWG. G-107-E13  
FOR SECTION OF BACKWALL DRAIN  
SEE DWG. G-107-E25

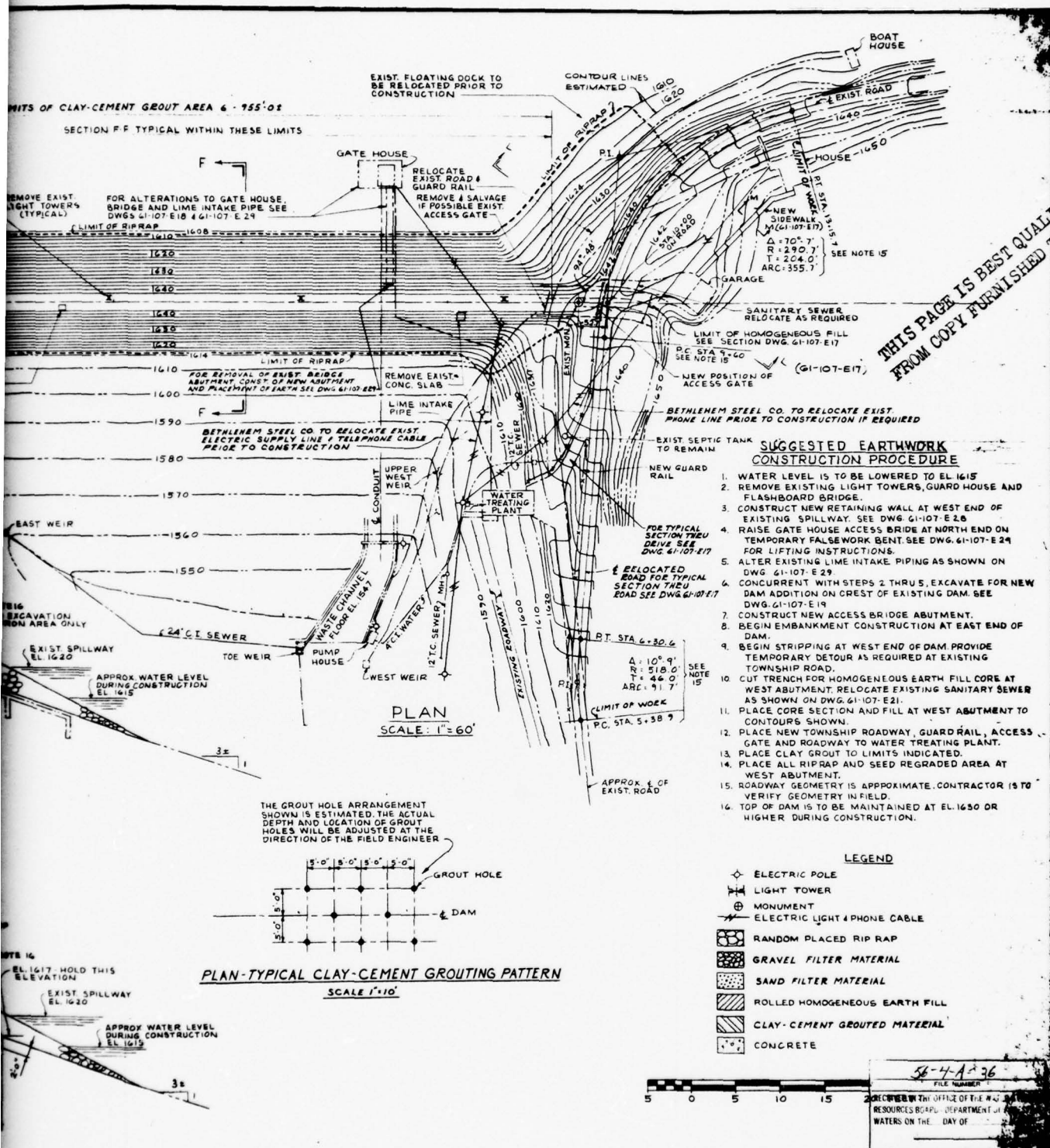
<b>E. D'APPOLONIA ASSOCIATES</b> CONSULTING ENGINEERS PITTSBURGH 21, PENNSYLVANIA	ENLARGEMENT OF CLEMATON RESERVOIR - SECTIONS AND DET. NEW AND EXISTING SPILLWAY AND SPILLWAY DETAILS - SHEET 1
<b>BETHLEHEM STEEL CO.</b> BETHLEHEM, PA.	RECEIVED IN THE OFFICE OF THE WATER & POWER RESOURCES BOARD - DEPARTMENT OF FORESTS & WATERS ON THE DAY OF A.D. 19... DRAWN BY: PKI CHECKED BY: GRS FILED:

DRAWN BY	G.J.G.	CHECKED BY	BE	DRAWING NUMBER	7-5-78
	6-23-78	APPROVED BY	JAP		7-5-78



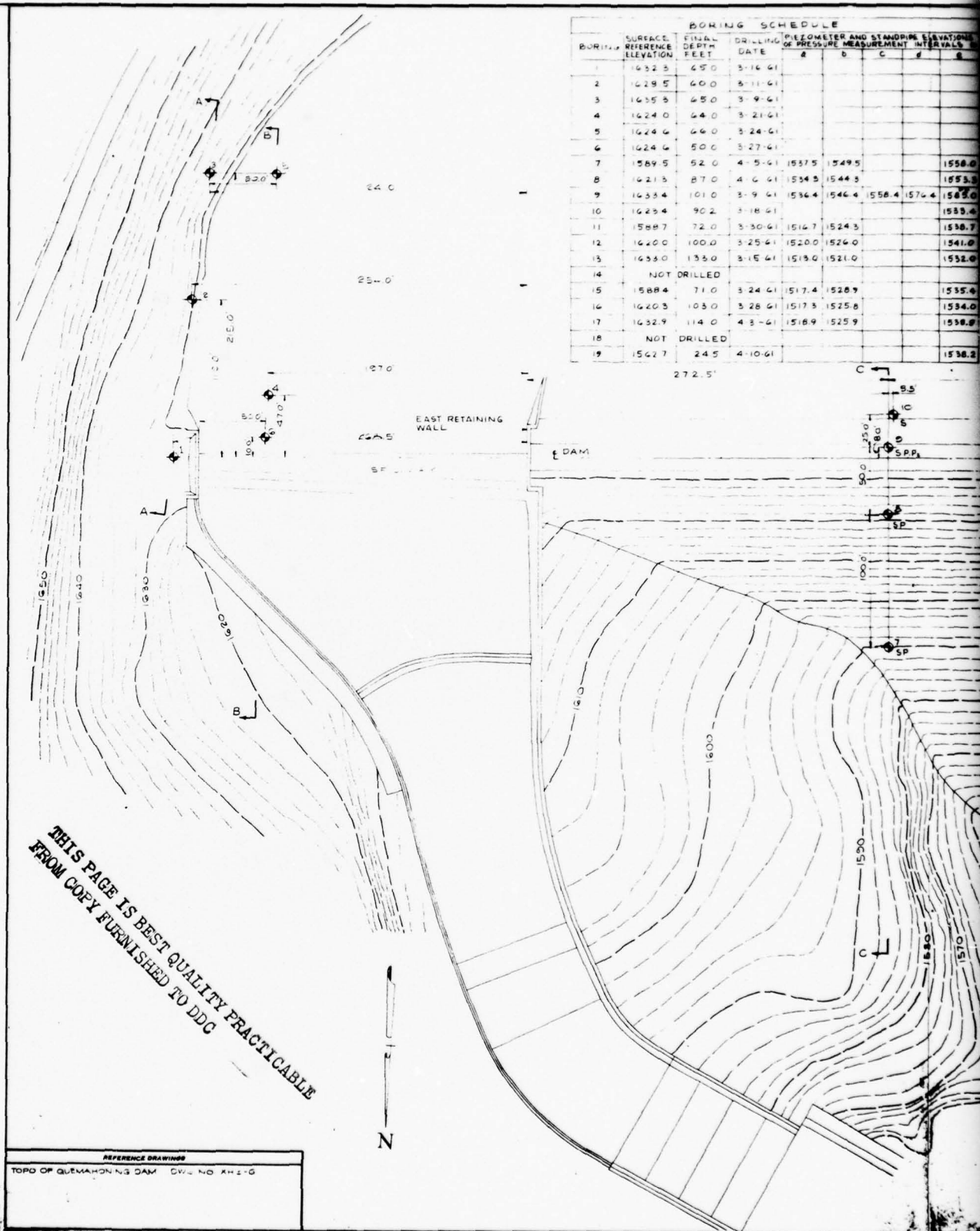
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 BY 6-23-78 APPROVED BY JHP 7-5-78 NUMBER



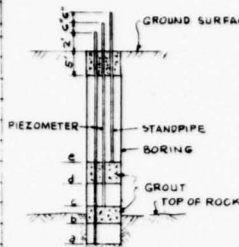
BORING SCHEDULE									
BORING	SURFACE REFERENCE ELEVATION	FINAL DEPTH FEET	DRILLING DATE	PIEZOMETER AND STANDING ELEVATIONS OF PRESSURE MEASUREMENT INTERVALS					
				A	B	C	D	E	
1	1632.5	65.0	3-16-61						
2	1629.5	60.0	3-11-61						
3	1635.3	45.0	3-9-61						
4	1624.0	54.0	3-21-61						
5	1624.6	66.0	3-24-61						
6	1624.6	50.0	3-27-61						
7	1589.5	52.0	4-5-61	1537.5	1549.5				1558.0
8	1621.3	87.0	4-6-61	1534.5	1544.5				1553.5
9	1633.4	101.0	3-9-61	1536.4	1546.4	1558.4	1574.4		1583.0
10	1623.4	90.2	3-18-61						1583.4
11	1588.7	72.0	3-30-61	1514.7	1524.5				1538.7
12	1620.0	100.0	3-25-61	1520.0	1526.0				1541.0
13	1633.0	133.0	3-15-61	1519.0	1521.0				1532.0
14	NOT DRILLED								
15	1588.4	71.0	3-24-61	1517.4	1528.9				1535.4
16	1620.3	103.0	3-28-61	1517.3	1525.8				1534.0
17	1632.9	114.0	4-3-61	1518.9	1525.9				1538.0
18	NOT DRILLED								
19	1542.7	24.5	4-10-61						1538.2



MODULE

PIEZOMETER AND STANDPIPE ELEVATIONS  
OF PRESSURE MEASUREMENT INTERVALS \*

#	B	C	#	E
1537.5	1549.5			1558.0
1534.5	1544.5			1553.3
1536.4	1546.4	1558.4	1576.4	1582.0
				1533.4
1516.7	1524.5			1538.7
1520.0	1526.0			1541.0
1513.0	1521.0			1532.0
1517.4	1528.9			1535.4
1517.3	1525.8			1534.0
1518.9	1525.9			1538.9
				1538.2



- NOTES:
1. FOR BORING LOGS SEE DWGS. G1-107-E.1, G1-107-E.6 AND G1-107-E.7
  2. FOR CROSS SECTIONS SEE DWGS. G1-107-E.2 AND G1-107-E.3
  3. \*\* TWO PIEZOMETERS PLACED IN BORING 9
  4. CONTOURS OF EXISTING DAM SURFACE OBTAINED FROM PROPOSED ORIGINAL DESIGN DRAWINGS. TOP OF BORING ELEVATIONS OBTAINED FROM FIELD SURVEY MARCH 22, 1961.

NOTE: DEEPEST PIPE HAS LEAST STICKUP ABOVE GROUND SURFACE AND SHALLOWER PIPES ARE APPROXIMATELY 6 INCHES HIGHER SUCCESSIVELY.

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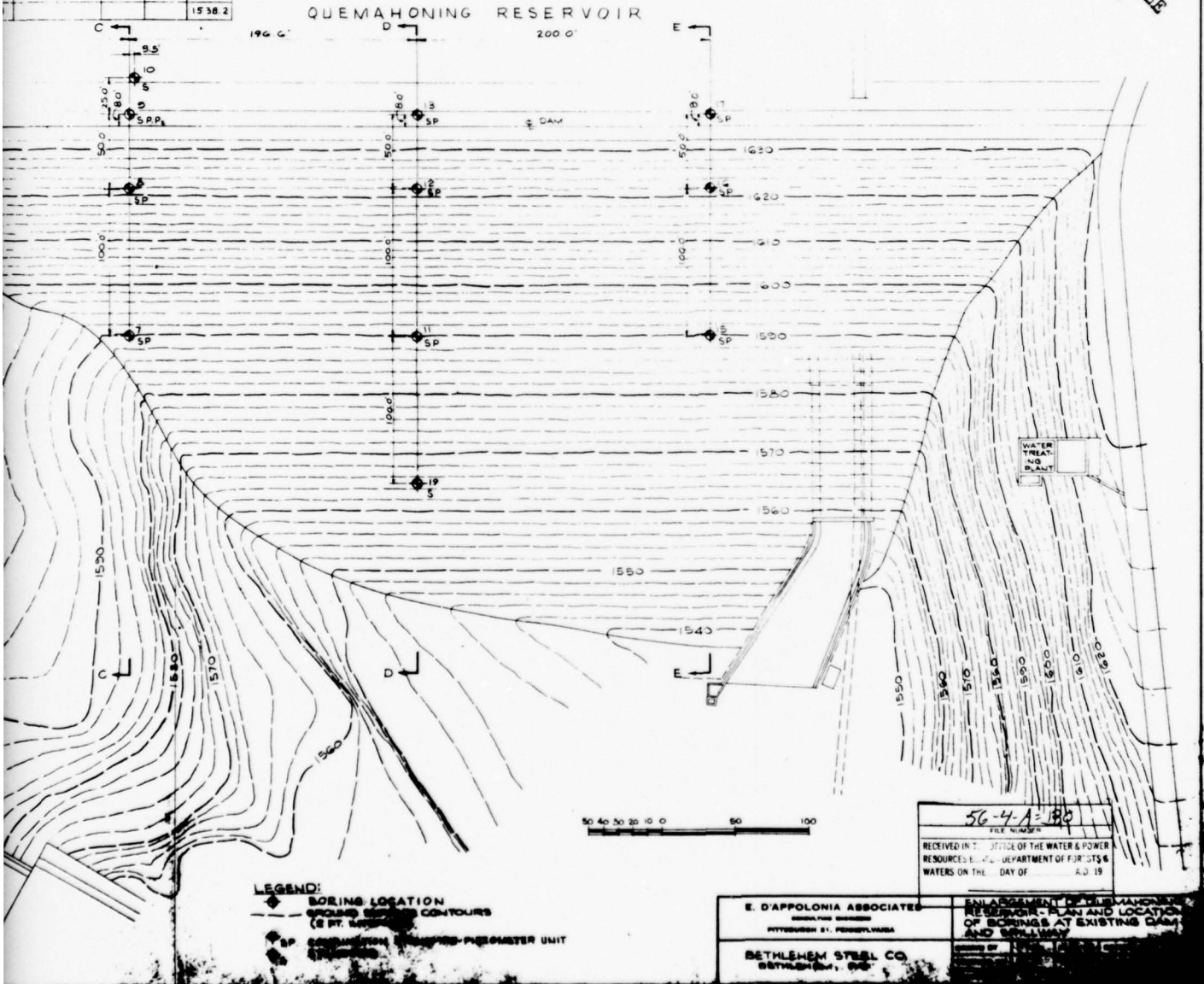
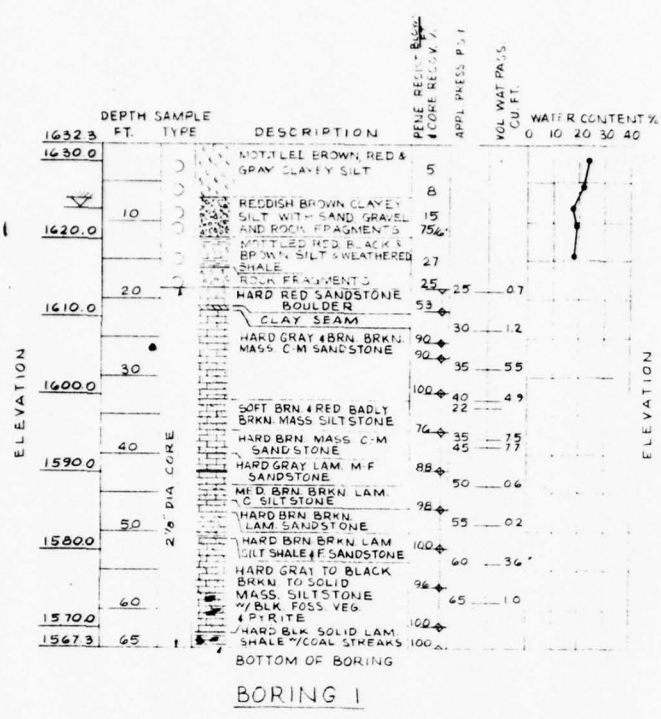


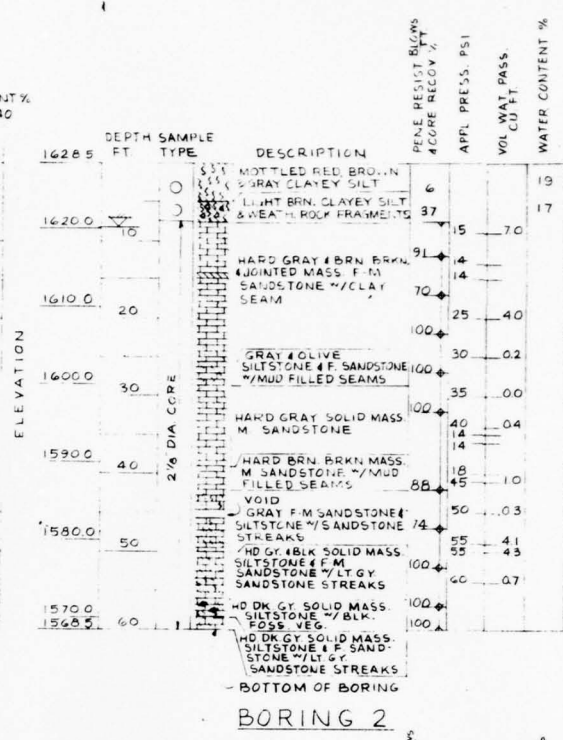
PLATE 7

D'APPOLONIA

DRAWN BY G. J. G. CHECKED BY J. S. J. APPROVED BY J. S. J. DRAWING 78-1-B68 NUMBER 7-5-78



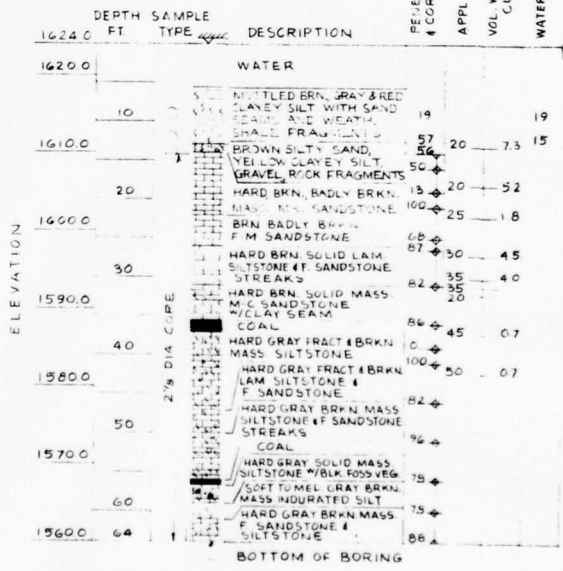
BORING 1



BORING 2

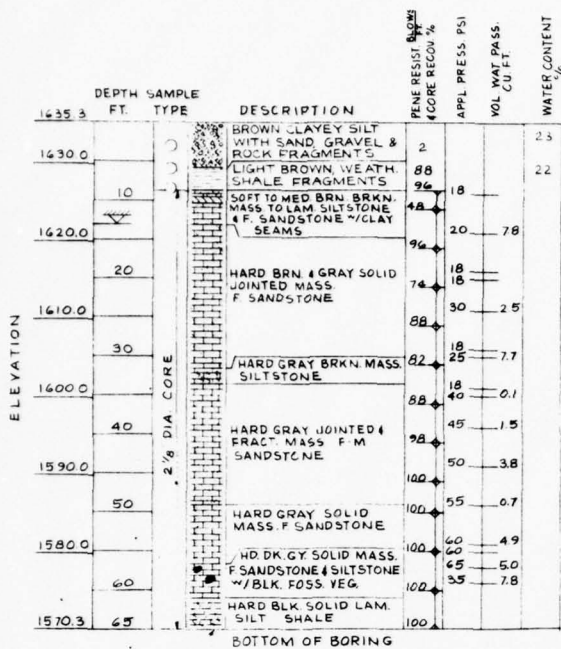


BORING 6

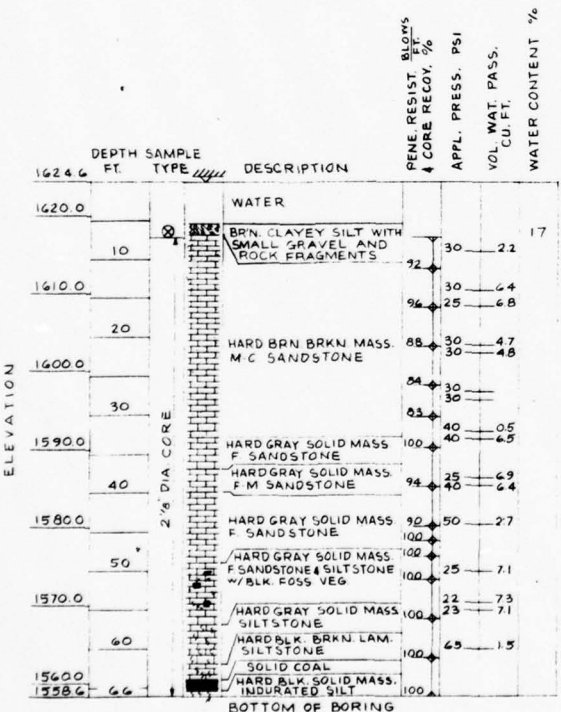


BORING 4

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**BORING 3**



**BORING 5**

### LEGEND



### ABBREVIATIONS

PENE. RESIST.	PENETRATION RESISTANCE
APPL. PRESS.	APPLIED PRESSURE
VOL. WAT. PASS.	VOLUME WATER PASSED
MASS.	MASSIVE
LAM.	LAMINATED
BRKN.	BROKEN
FRAC.	FRACTURED
CARBO.	CARBONACEOUS
FOSS. VEG.	FOSSILIZED VEGETATION
WEATH.	WEATHERED
F.M.	FINE TO MEDIUM
C.M.	COARSE TO MEDIUM
F.	FINE
M.	MEDIUM
C.	COARSE
BRN.	BROWN
BLK.	BLACK
GY.	GRAY
LT.	LIGHT
DK.	DARK
STRKS.	STREAKS
HD.	HARD
MED.	MEDIUM
SOFT.	SOFT

STRUCTURE

CONDITION

GRAIN SIZE

COLOR

HARDNESS

### GENERAL NOTES

1. ALL VALUES SHOWN IN COLUMNS HEADED "APPLIED PRESSURE" AND "VOLUME OF WATER PASSED" ARE FOR WATER PRESSURE TESTS RUN FOR A PERIOD OF 5 MINUTES.
2. ALL PRESSURE TESTS WERE MADE IN 5 FOOT INCREMENTS BEGINNING AT THE BOTTOM OF THE PRE-DRILLED HOLE.
3. WATER LEVEL SHOWN IN BORING LOG DENOTES DEPTH TO WATER SURFACE MEASURED FROM TOP OF BORING UPON COMPLETION OF DRILLING.
4. PENETRATION RESISTANCE IN BLOWS PER FOOT IS THE NUMBER OF BLOWS REQUIRED TO DRIVE A 2 INCH O.D. SPLIT SPOON SAMPLER 12 INCHES USING A 140 POUND HAMMER FALLING 30 INCHES.
5. FOR PLAN AND LOCATION OF BORINGS SEE DWG. NO. 61-107-E1

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56-4-A-33

FILE NUMBER

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WATER ON THE 10th 19

File Class

E. D'APPOLONIA ASSOCIATES CONSULTING ENGINEERS PITTSBURGH 21, PENNSYLVANIA	ENLARGEMENT OF QUEMAHONING RESERVOIR - BORING LOGS BORINGS 1, 2, 3, 4, 5, 6 SHEET 1		
	DRAWN BY	SL	4-11-61
BETHLEHEM STEEL CO. BETHLEHEM, PA.	CHECKED BY	SLM	5-2-61
	APPROVED BY	SL	7-12-61
	SCALE	1" = 10' VERT.	
	DRAWING NO.	61-107-E1	

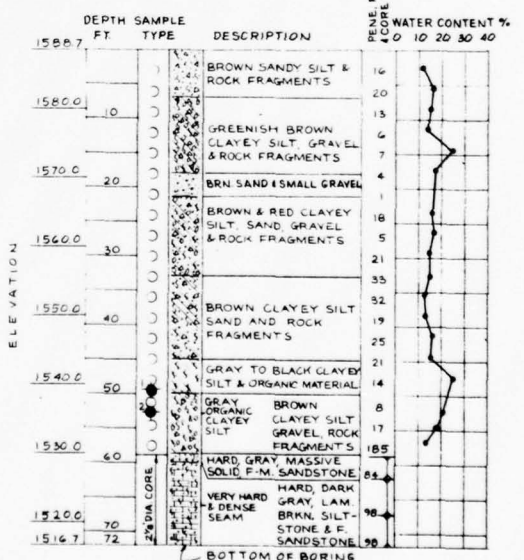
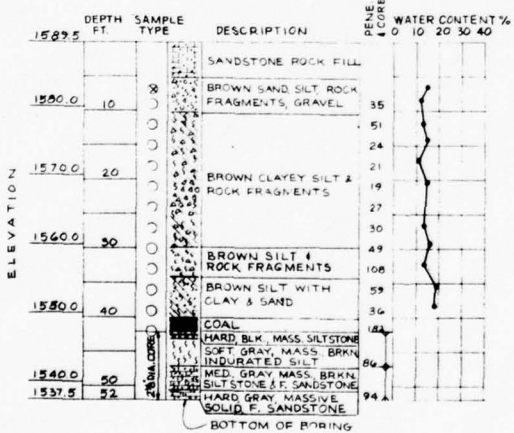
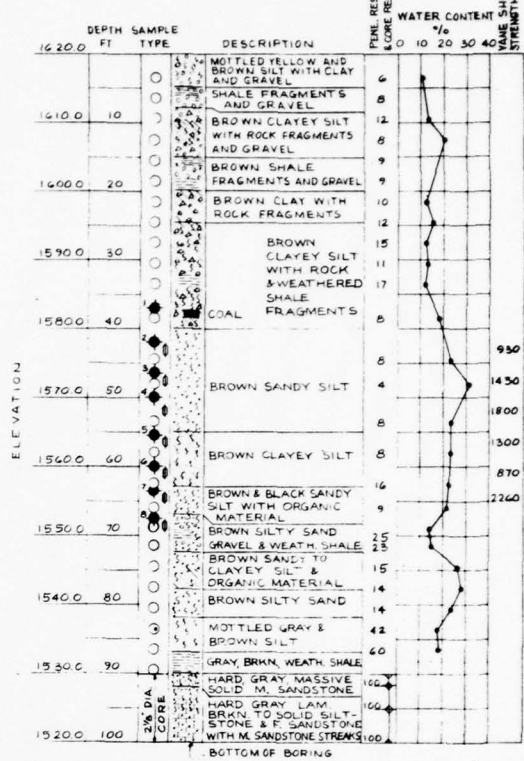
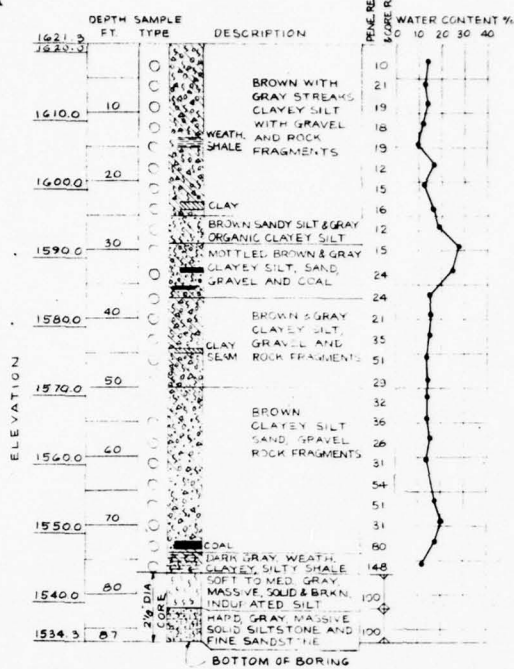
PLATE 8

**D'APPOLONIA**

2

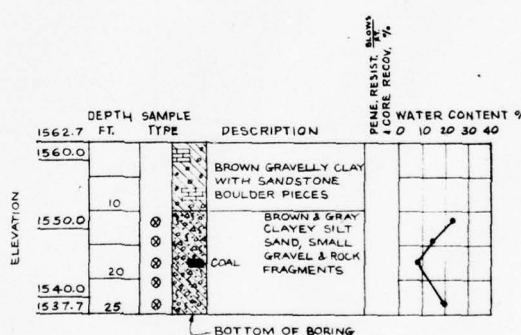
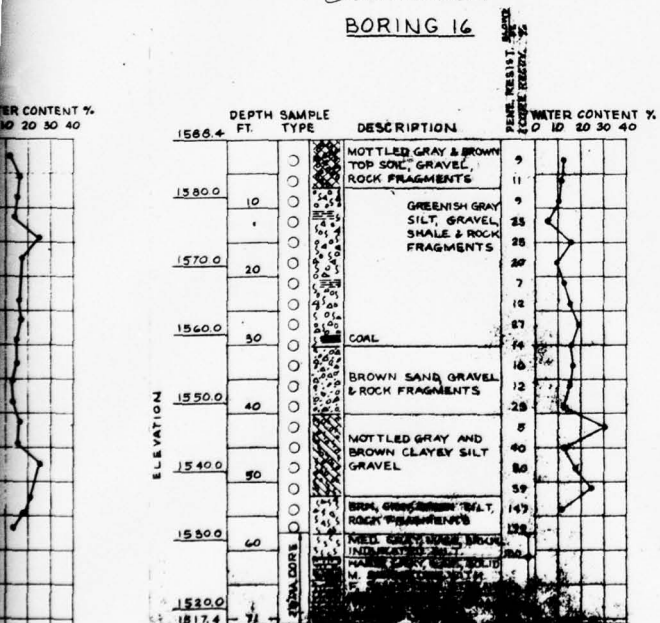
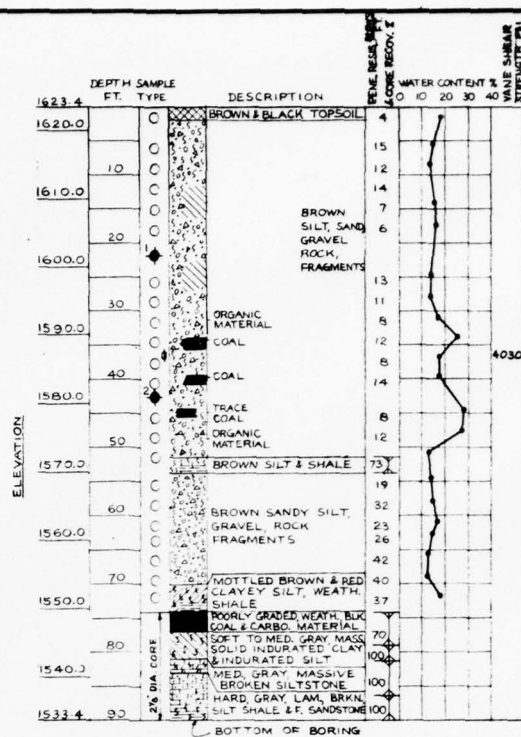
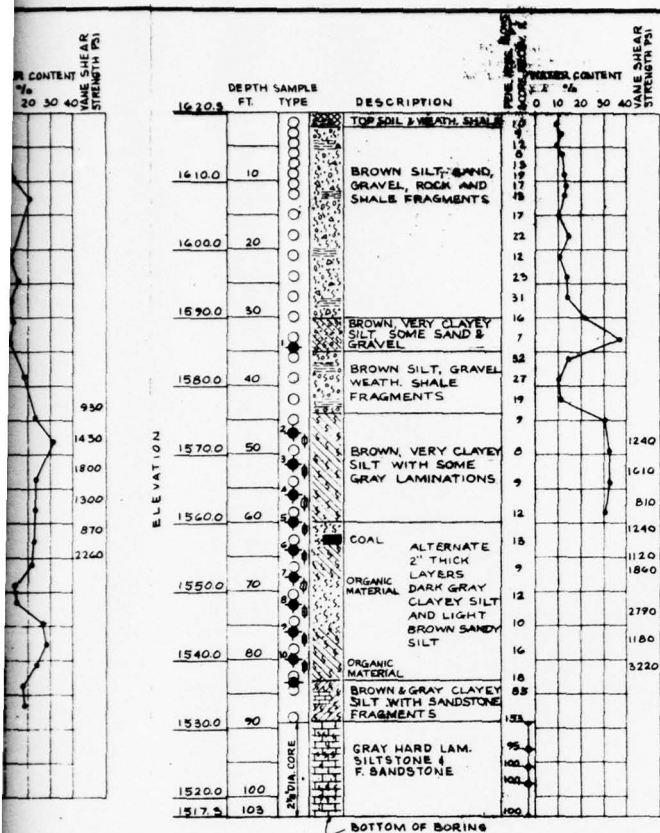


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 6-23-78 APPROVED BY SMD 7-5-78 NUMBER



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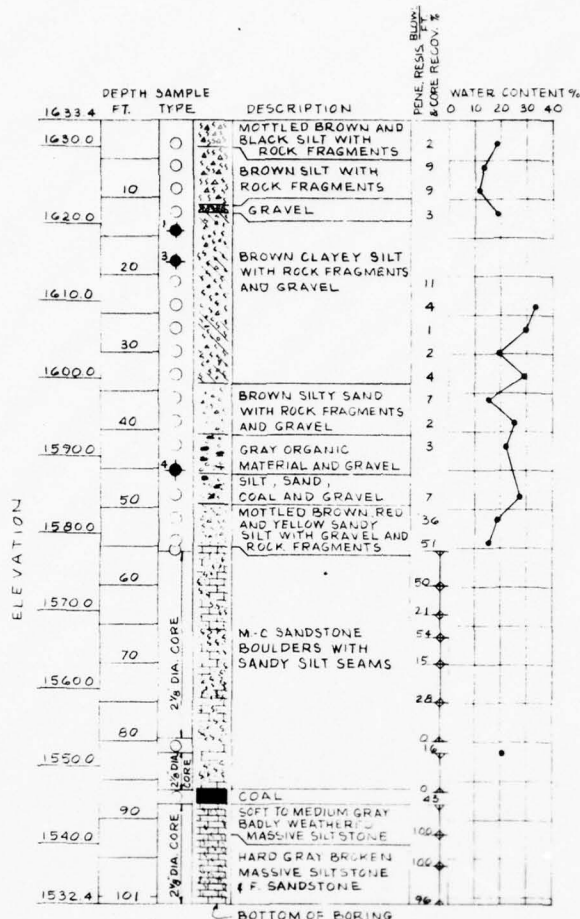
NOTES  
1. FOR GENERAL NOTES, LEGEND AND ABBREVIATIONS  
SEE DWG. 61-107 E 7

56-4A-32  
FILE NUMBER  
RECEIVED IN THE OFFICE OF THE WATER & FOREST  
RESOURCES BOARD - DEPARTMENT OF FOREST  
WATERS ON THE DAY OF 1961

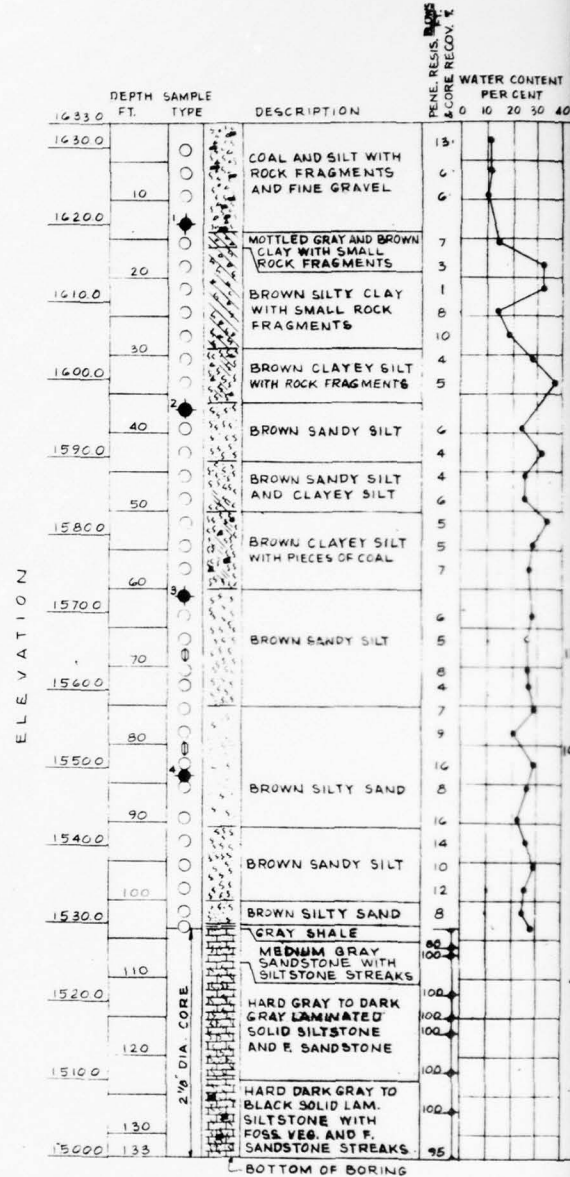
E. D'APPOLONIA ASSOCIATES  
CONSULTING ENGINEERS  
1720 MONROE ST. PITTSBURGH, PA.  
BETHLEHEM STEEL

PHILADELPHIA  
FEBRUARY 1964  
EDWARD K. ...

DRAWN BY G J G CHECKED BY BE-75-78 DRAWING 78 4-B70  
 6-22-78 APPROVED BY SJP 75-78

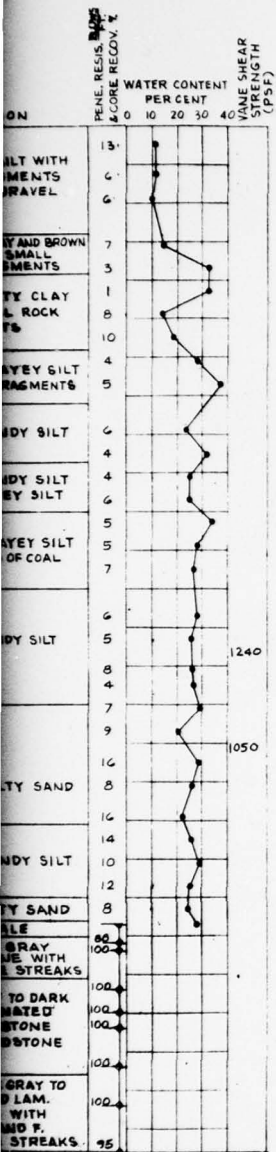


BORING 9



BORING 13

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DEPTH	SAMPLE	DESCRIPTION	PENETRATION	WATER	UNSATURATED	WATER	DIRECT SHEAR
FEET	TYPE		RESISTANCE	CONTENT	STRENGTH	CONTENT	TEST RESULTS
			BLDS PER FT.	PER CENT	(PSF)	PER CENT	ANGLE OF INTERNAL FRICTION (DEG)
1632.9	0	BLACK TO GRAY SANDSTONE & SHALE PIECES					
1620.0	10	GRAY & BROWN SANDSTONE & SHALE PIECES WITH SILT & CLAY BINDER					
1613.0	20	GRAY & BROWN GRAVEL, SANDY CLAYEY SILT, LENSES OF CLAYEY SILT & SANDY SILT			860	870	
1600.0	30				745	21°	280
1590.0	40	BROWN CLAYEY SILT, LENSES OF SANDY SILT, VERY CLAYEY SILT, GRAVELLY SANDY SILT			210		
1580.0	50				1512	28°	120
1570.0	60	YELLOWISH BROWN VERY CLAYEY SILT			1430	27°	390
1560.0	70	BROWN CLAYEY SILT			1110	10°	420
1550.0	80	YELLOWISH BROWN VERY CLAYEY SILT			1450	21°	580
1540.0	90	BROWN CLAYEY SILT			1530		
1530.0	100	DARK GRAY SANDY CLAYEY SILT WITH POWDERED COAL			1610		
1520.0	110	YELLOWISH BROWN VERY CLAYEY SILT			1550	9°	510
1510.0	120	YELLOWISH BROWN SANDY CLAYEY SILT			1030	20°	250
1500.0	130	YELLOWISH BROWN VERY CLAYEY SILT			1015		
1490.0	140	BROWN SANDY CLAYEY SILT			960		
1480.0	150	BRN. VERY CLAYEY SILT			620		
1470.0	160	SOFT TO MED. HD. GRAY MASS. SOLID INDURATED SILT			1136		
1460.0	170	GRAY MASS. F. SANDSTONE			1055		
1450.0	180	HARD STREAK-HEAVY - POSSIBLY GROUT			135		
1440.0	190	GRAY FINE SANDSTONE AND SILTSTONE			1030	10°	440

## BORING 17

### NOTES

1. FOR GENERAL NOTES, LEGEND AND ABBREVIATIONS SEE DWG. 61-107 E-7

56-4-A-31  
FILE NUMBER  
RECEIVED IN THE OFFICE OF THE WATER & POWER RESOURCES BOARD - DEPARTMENT OF FORESTS & WATER ON THE DAY OF AD 19  
File Clerk

E. D'APPOLONIA ASSOCIATES CONSULTING ENGINEERS PITTSBURGH 21, PENNSYLVANIA	ENLARGEMENT OF QUEMAHONING RESERVOIR - BORING LOGS BORINGS 9, 13, 17 SHEET 2
BETHLEHEM STEEL CO BETHLEHEM, PA.	DRAWN BY SL 4-7-61 SCALE 1"=10' 1/2" CHECKED BY DCH 5-2-61 APPROVED BY SB 7-12-61 61-107

PLATE 10

**D'APPOLONIA**

DRAWN BY	D.J.D.	CHECKED BY	BE	7-5-78	DRAWING NUMBER	78-1-A13
	6-20-78	APPROVED BY	SEP	7-5-78		

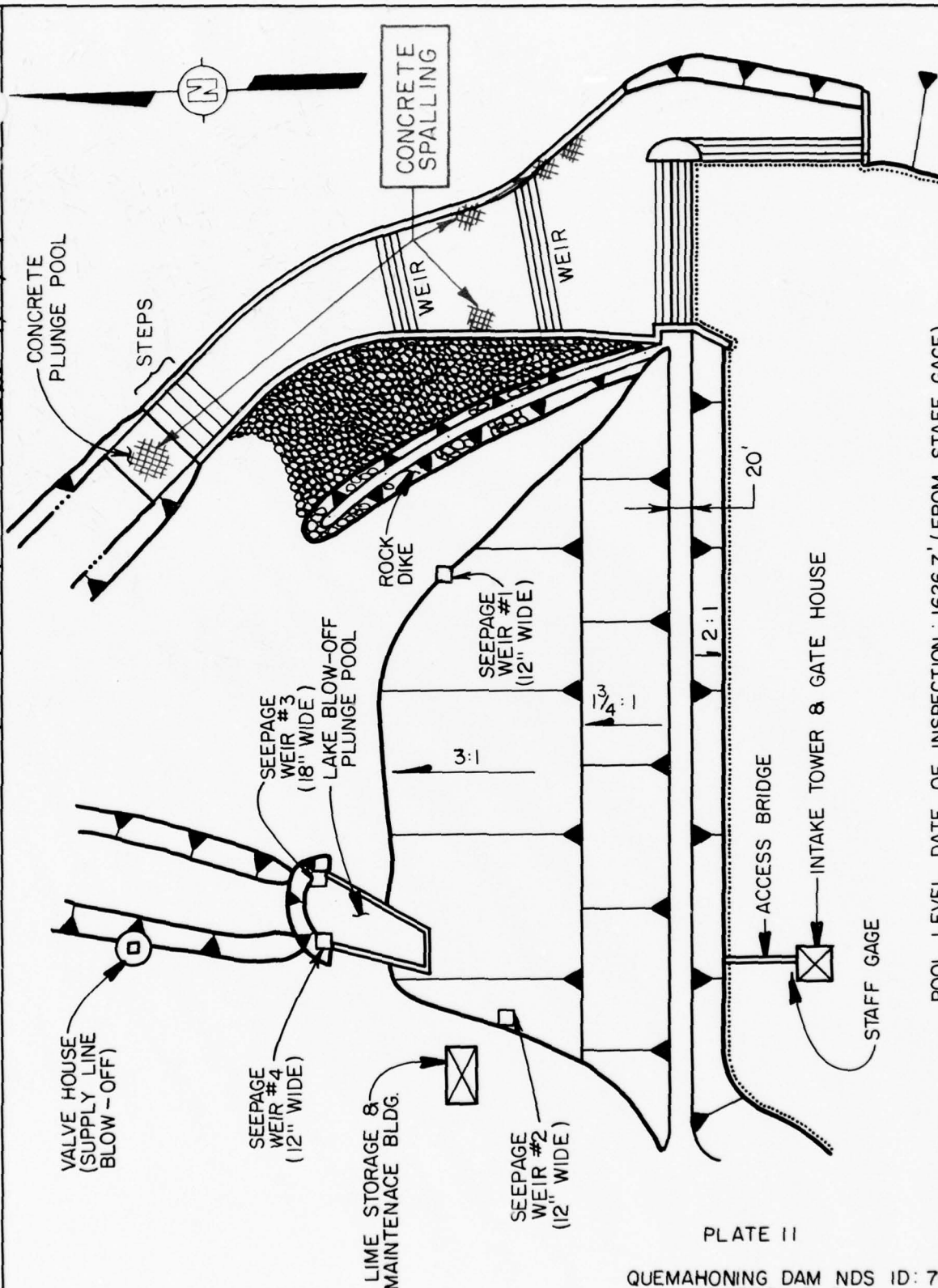


PLATE II

QUEMAHONING DAM NDS ID: 740  
 GENERAL PLAN  
 FIELD INSPECTION NOTES  
 FIELD INSPECTION DATE : JUNE 9 , 1978

**D'APPOLONIA**



APPENDIX A  
CHECKLIST  
VISUAL INSPECTION  
PHASE I

CHECKLIST  
VISUAL INSPECTION  
PHASE I

NAME OF DAM QUEMAHNING DAM COUNTY SOMERSET STATE PENNSYLVANIA ID# NDI:740 DER:56-4  
TYPE OF DAM EARTH FILL HAZARD CATEGORY HIGH  
DATE(S) INSPECTION JUNE 9, 1978 WEATHER RAINY TEMPERATURE 70<sup>+</sup>  
POOL ELEVATION AT TIME OF INSPECTION 1627 M.S.L. TAILWATER AT TIME OF INSPECTION 1542<sup>+</sup> M.S.L.

INSPECTION PERSONNEL:

<u>BILGIN EREL</u>	REVIEW INSPECTION BY:	<u>ELIO D'APPOLONIA</u>
<u>WAH-TAK CHAN</u>	<u>(JUNE 12, 1978)</u>	<u>LARRY ANDERSEN</u>
		<u>JAMES POELLOT</u>

BILGIN EREL RECORDER

VISUAL INSPECTION  
PHASE 1  
EMBANKMENT

NAME OF DAM QUE MAHONING M  
ID# NDI: 740 DER: 56-4

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	NONE FOUND.	
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	NONE FOUND	
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	NONE FOUND	
VERTICAL AND HORIZONTAL ALIGNMENT OF THE CREST	NO PERCEIVABLE MISALIGNMENT	
RIPRAP FAILURES	NONE.	

VISUAL INSPECTION  
PHASE 1  
EMBANKMENT

NAME OF DAM QUEMAMONING DAM  
ID# NDI: 740 PER: 56-4

VISUAL EXAMINATION OF JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
	NO SIGNS OF DISTRESS.	
ANY NOTICEABLE SEEPAGE	NO UNCONTROLLED SEEPAGE. THERE ARE FOUR WEIRS AT THE SITE FOR MEASURING SEEPAGE THROUGH THE DAM.	SEEPAGE FLOWS ARE DAILY RECORDED BY THE DAM TENDER
STAFF GAGE AND RECORDER	STAFF GAGE IS LOCATED ON INTAKE TOWER. DAILY READINGS ARE TAKEN BY THE DAM TENDER.	
DRAINS	NONE	



VISUAL INSPECTION  
PHASE I  
CONCRETE/MASONRY DAMS

NAME OF DAM QUEMAHONING DAM

ID# NDI: 740 DEP: 56-4

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
ANY NOTICEABLE SEEPAGE	EARTH FILL DAM N/A	
STRUCTURE TO ABUTMENT/EMBANKMENT JUNCTIONS	N/A	
DRAINS	N/A	
WATER PASSAGES	N/A	
FOUNDATION	N/A	

VISUAL INSPECTION  
 PHASE 1  
 CONCRETE/MASONRY DAMS

NAME OF DAM QUEMARENING DAM

ID# NDI:740 DER:56-4

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS CONCRETE SURFACES	(EARTH FILL DAM)  N/A	
STRUCTURAL CRACKING	N/A	
VERTICAL AND HORIZONTAL ALIGNMENT	N/A	
MONOLITH JOINTS	N/A	
CONSTRUCTION JOINTS  STAFF GAGE OF RECORDER:	N/A	

VISUAL INSPECTION

PHASE I

OUTLET WORKS

NAME OF DAM QUEMASHON DAM

ID# NDI: 740 DER: 56-4

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT	OUTLET CONDUIT IS A 20 FT HIGH 30 FT WIDE TUNNEL. THE WALLS AND THE ROOF WAS WET. NUMEROUS MINOR CRACKS. TOTAL FLOW SEEPAGE FROM THE TUNNEL ABOUT 5 GPM.	
INTAKE STRUCTURE	CONCRETE INTAKE TOWER. NO SIGNS OF DISTRESS ON VISIBLE PORTIONS.	
OUTLET STRUCTURE	CONCRETE PLUNGE POOL. GOOD CONDITION.	
OUTLET CHANNEL	TRAPEZOIDAL EARTH CHANNEL (BANKS RIPRAPPED)	
EMERGENCY GATE	A SLUICE GATE DISCHARGING INTO DIVERSION TUNNEL. OPERATION NOT OBSERVED. HOWEVER OPERATING EQUIPMENT APPEARS TO BE ADEQUATELY MAINTAINED.	LAKE CAN ALSO BE DRAINED THROUGH SERVICE LINE BLOW-OFF. THE VALVE OPERATED AND OBSERVED TO BE FUNCTIONAL

VISUAL INSPECTION  
PHASE 1  
UNGATED SPILLWAY

NAME OF DAM QUEMANHONG DAM  
ID# NDI:720 DER:56-4

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE WEIR	GOOD CONDITION.	
APPROACH CHANNEL	LAKE	
DISCHARGE CHANNEL	CONCRETE SPALLING AT VARIOUS LOCATIONS.	
BRIDGE AND PIERS	NONE	



VISUAL INSPECTION  
PHASE I  
GATED SPILLWAY

NAME OF DAM QUEMAHONG AM

ID#NDI:740 PER:56-4

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE SILL	(NO GATED SPILLWAY)  N/A	
APPROACH CHANNEL	N/A	
DISCHARGE CHANNEL	N/A	
BRIDGE PIERS	N/A	
GATES AND OPERATION EQUIPMENT	N/A	

VISUAL INSPECTION  
PHASE I  
INSTRUMENTATION

NAME OF DAM QUEMAHUNG DAM  
ID# NOI: 740 DER: 56-4

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
MONUMENTATION/SURVEYS	NONE FOUND	
OBSERVATION WELLS	NONE FOUND.	
WEIRS	THERE ARE FOUR WEIRS TO MONITOR SEEPAGE.	
PIEZOMETERS	1961 DRAWINGS SHOW 10 PIEZOMETERS WERE INSTALLED. THREE WERE LOCATED AT THE SITE. DAM TENDER REPORTED THAT THEY ARE NOT BEING MONITORED.	
OTHER	NONE	

VISUAL INSPECTION  
PHASE I  
RESERVOIR  
OBSERVATIONS

NAME OF DAM QUEMATHONNE DAM  
ID# NDI:740 DER:56-4

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SLOPES	No SIGNS OF UNUSUAL EROSION SLOPES GENTLE.	
SEDIMENTATION	UNKNOWN.	

VISUAL INSPECTION  
 PHASE I  
 DOWNSTREAM CHANNEL

NAME OF DAM QUEMAHONING AM  
 ID# NDI:740 DEP:56-4

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)	NO SIGNIFICANT OBSTRUCTIONS,	
SLOPES		
APPROXIMATE NUMBER OF HOMES AND POPULATION	TOWNS OF HOLLISPOLE AND BENSON. OVER 100 HOMES IN POTENTIAL FLOOD PLAIN IN THE EVENT OF DAM FAILURE POPULATION: ~500	

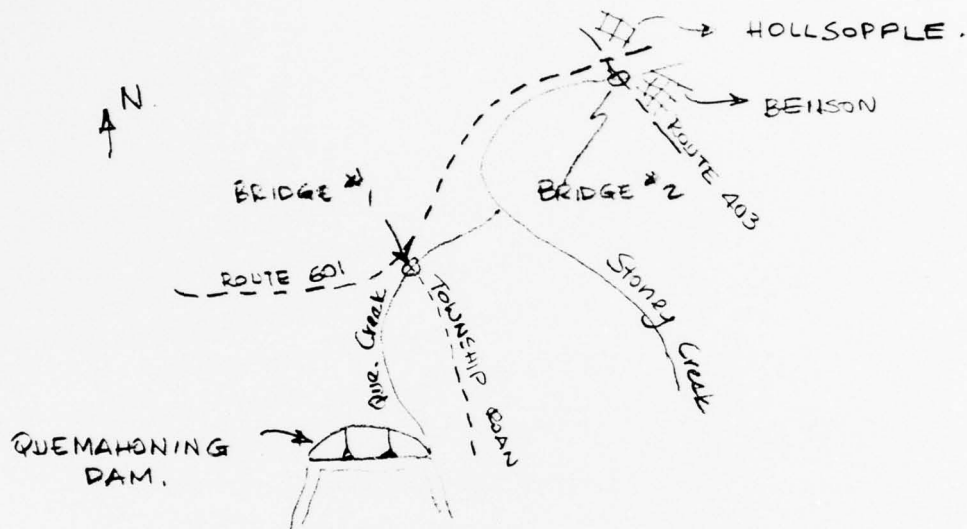


# D'APPOLONA

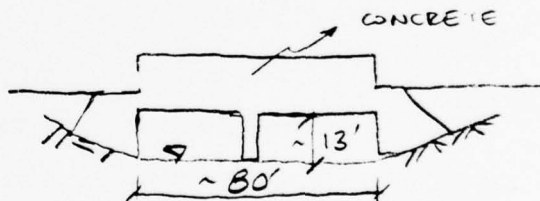
CONSULTING ENGINEERS, INC.

By E Date 6-8-78 Subject QUEMAHONING DAM NDI: 742 Sheet No. 1 of 1  
Chkd. By WTC Date 6-8-78 FIELD INSPECTION SKETCH Proj. No. 73-114-07

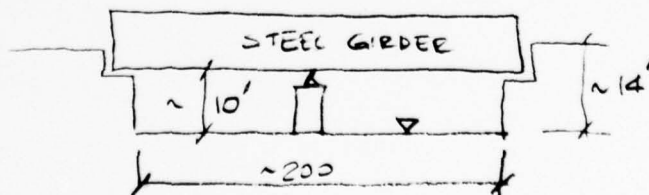
## STREAM CROSS-SECTION & BRIDGE LOCATIONS



BRIDGE # 1



BRIDGE # 2 (OVER STONEY CREEK)



APPENDIX B  
CHECKLIST  
ENGINEERING DATA  
DESIGN, CONSTRUCTION, OPERATION  
PHASE I

CHECKLIST  
ENGINEERING DATA  
DESIGN, CONSTRUCTION, OPERATION  
PHASE I

NAME OF DAM QUEMAHONING DAM  
ID# NDI : 740 DER: 56-4

ITEM	REMARKS
AS-BUILT DRAWINGS	AVAILABLE IN STATE FILES.
REGIONAL VICINITY MAP	SEE PLATE 2
CONSTRUCTION HISTORY	DESIGNED & BUILT BY THE ENGINEERS OF MANUFACTURERS WATER COMPANY, DURING 1909 & 1912. DAM WAS ENLARGED IN 1961.
TYPICAL SECTIONS OF DAM	HYDRAULIC FILL DAM. GRADUALLY ZONED. FINEST MATERIAL AT THE CORE
OUTLETS - PLAN - DETAILS - CONSTRAINTS - DISCHARGE RATINGS	NOT AVAILABLE

CHECKLIST  
ENGINEERING DATA  
DESIGN, CONSTRUCTION, OPERATION  
PHASE I

NAME OF DAM QUEMAMONING DAM  
ID# NDI: 740 DER: 56-4

ITEM	REMARKS
RAINFALL/RESERVOIR RECORDS	RECORDED SINCE 1915.
DESIGN REPORTS	NO ORIGINAL DESIGN REPORT IS AVAILABLE. 1961 DESIGN REPORT WAS PREPARED BY D'APOLONIA ASSOCIATES CONSULTING ENGINEERS.
GEOLOGY REPORTS	SAME AS ABOVE
DESIGN COMPUTATIONS HYDROLOGY & HYDRAULICS DAM STABILITY SEEPAGE STUDIES	AVAILABLE
MATERIALS INVESTIGATIONS BORING RECORDS LABORATORY FIELD	AVAILABLE



CHECKLIST  
ENGINEERING DATA  
DESIGN, CONSTRUCTION, OPERATION  
PHASE I

NAME OF DAM QUEMAHONG DAM  
ID# NDI:740 DER:56-4

ITEM	REMARKS
POST CONSTRUCTION SURVEYS OF DAM	NONE REPORTED AFTER 1961.
BORROW SOURCES	RIGHT & LEFT ABUTMENTS (SHOWN IN CONSTRUCTION PHOTOGRAPHS)
MONITORING SYSTEMS	NONE
MODIFICATIONS	IN 1961 THE DAM AND THE SPILLWAY WAS ENLARGED.
HIGH POOL RECORDS	RECORDED SINCE 1915. 1936 FLOOD STAGE 5.4 FT OVER 250 FT WIDE SPILLWAY.

CHECKLIST  
ENGINEERING DATA  
DESIGN, CONSTRUCTION, OPERATION  
PHASE I

NAME OF DAM QUEMAHONING DAM  
ID# NDI: 740 VER: 56-4

ITEM	REMARKS
POST CONSTRUCTION ENGINEERING STUDIES AND REPORTS	STATE FILES INCLUDE NUMEROUS INSPECTION REPORTS. MOST RECENT INSPECTION WAS CONDUCTED IN 1976.
PRIOR ACCIDENTS OR FAILURE OF DAM DESCRIPTION REPORTS	NONE REPORTED.
MAINTENANCE OPERATION RECORDS	RECORDS ARE MAINTAINED BY THE DAM TENDER.
SPILLWAY PLAN SECTIONS DETAILS	SEE PLATES
OPERATING EQUIPMENT PLANS AND DETAILS	GATE OPERATING PLANS ARE POSTED AT THE INTAKE TOWER.

NAME OF DAM QUEMAHONING DAM

ID# NDI:740 DER:56-4

CHECKLIST  
HYDROLOGIC AND HYDRAULIC  
ENGINEERING DATA

DRAINAGE AREA CHARACTERISTICS: WOOD & PASTURE LANDS 94 SQ. MILES.  
ELEVATION; TOP NORMAL POOL AND STORAGE CAPACITY: 37,000 AC-FT @ EL 1627  
ELEVATION; TOP FLOOD CONTROL POOL AND STORAGE CAPACITY: 52,700 AC-FT @ EL 1642  
ELEVATION; MAXIMUM DESIGN POOL: EL  
ELEVATION; TOP DAM: 1642 FT (USGS DATUM)

CREST:

- a. Elevation 1642 FT
- b. Type EARTH
- c. Width 20 FT
- d. Length 955 FT
- e. Location Spillover NO NOTICABLE LOW SECTION
- f. Number and Type of Gates NONE

OUTLET WORKS:

- a. Type DIVERSION TUNNEL & SUPPLY LINE BLOW-OFF
- b. Location NEAR LEFT ABUTMENT
- c. Entrance Inverts UNKNOWN ESTIMATED 1550
- d. Exit Inverts UNKNOWN ESTIMATED 1540
- e. Emergency Draindown Facilities SAME AS OUTLET WORKS.

HYDROMETEOROLOGICAL GAGES:

- a. Type RAIN & STAFF GAGE
- b. Location DAM SITE
- c. Records AVAILABLE SINCE 1915

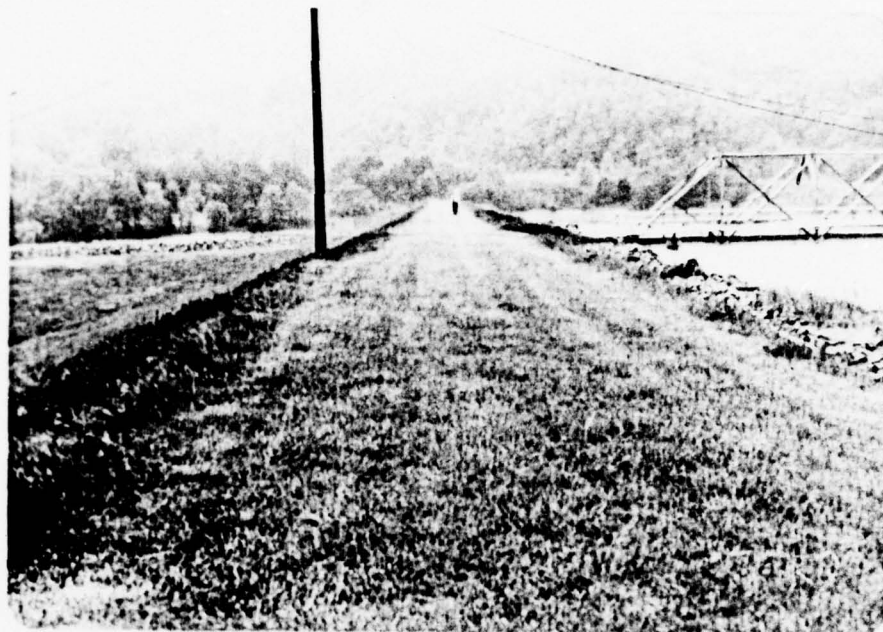
MAXIMUM NONDAMAGING DISCHARGE: SPILLWAY CAPACITY  $\approx$  90,000 CFS.

APPENDIX C  
PHOTOGRAPHS

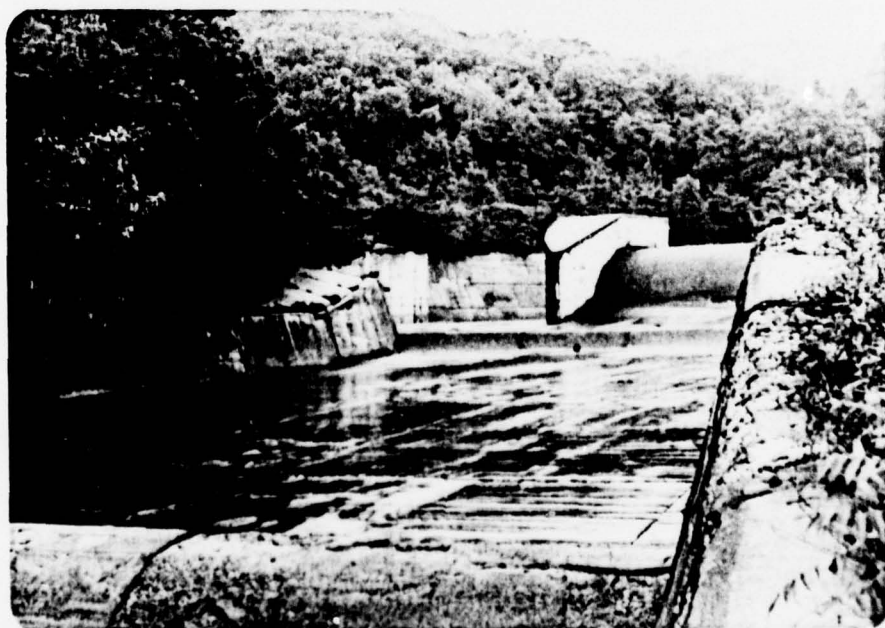


LIST OF PHOTOGRAPHS  
QUEMAHONING DAM  
JUNE 9, 1978

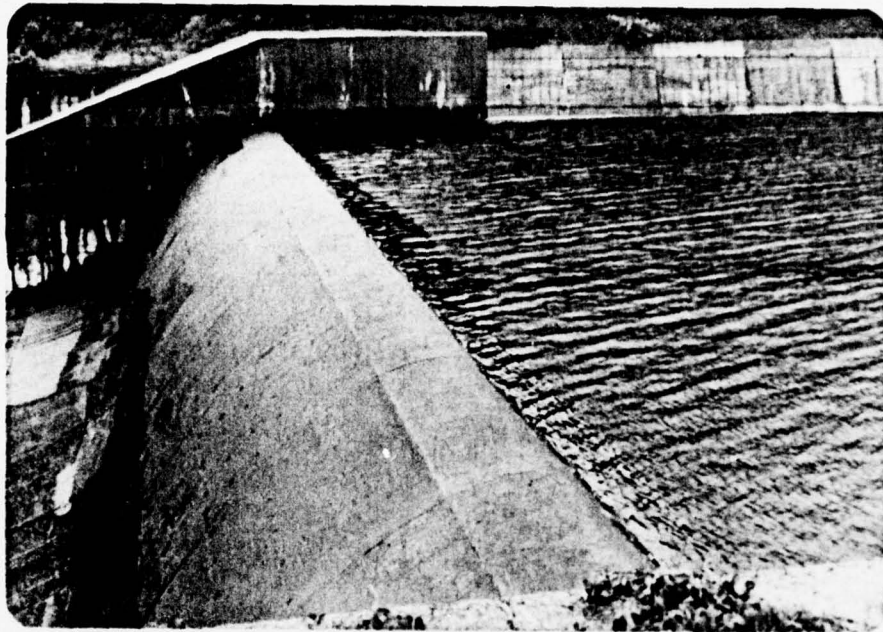
<u>PHOTOGRAPH NO.</u>	<u>DESCRIPTION</u>
1	Crest (looking east).
2	Spillway discharge channel.
3	Primary spillway crest.
4	Side channel spillway crest.
5	Intake tower.
6	Valve controls in intake tower.
7	Toe area (lake "blow-off" plunge pool; supply line "blow-off" valve house in background).
8	Supply line "blow-off" operating.
9	Supply line "blow-off" valve.
10	Spalling in spillway discharge channel.
11	Seepage weir on left abutment.
12	Seepage weir in lake "blow-off" plunge pool.
13	Bridge at Benson (looking east).
14	Bridge at Benson (looking west).



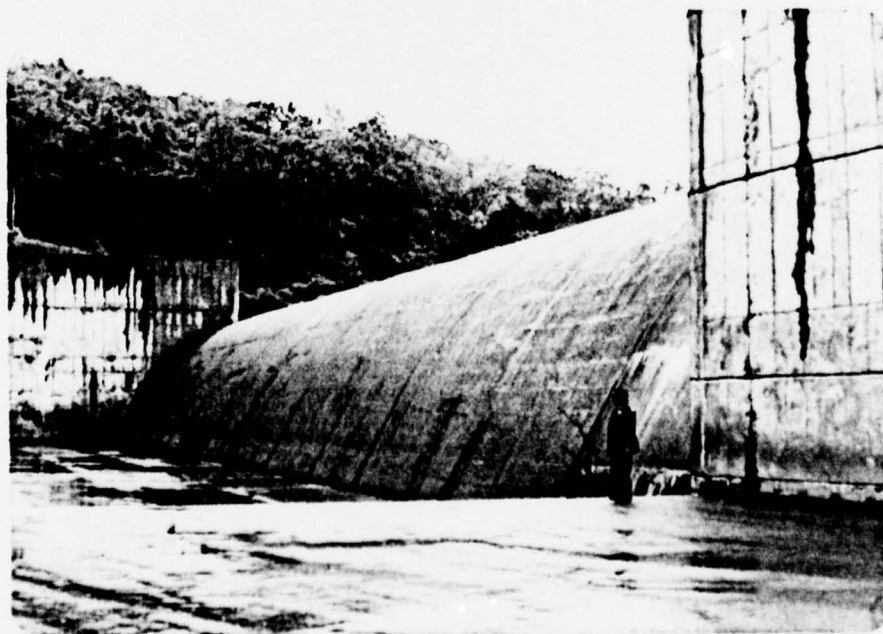
Photograph No. 1  
Crest (looking east).



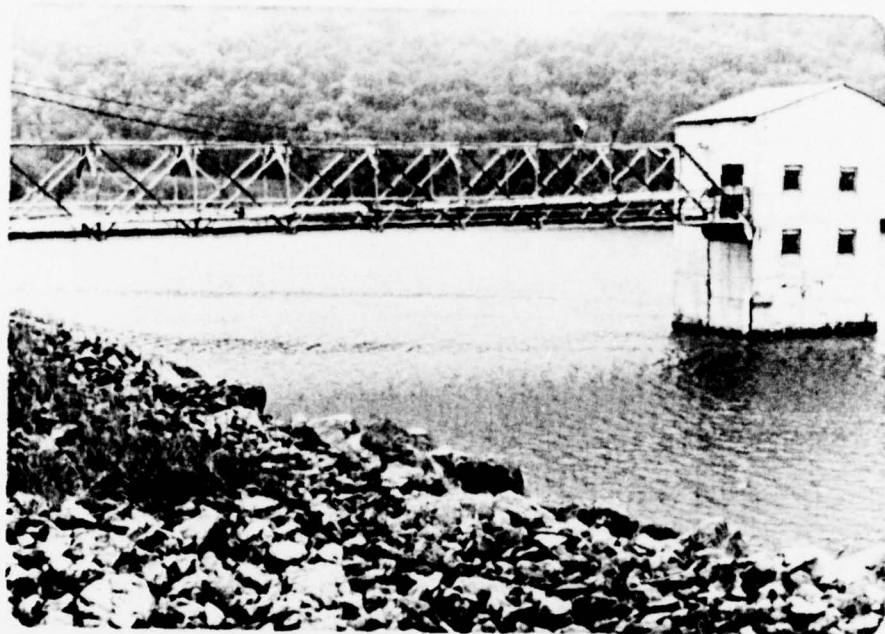
Photograph No. 2  
Spillway discharge channel.



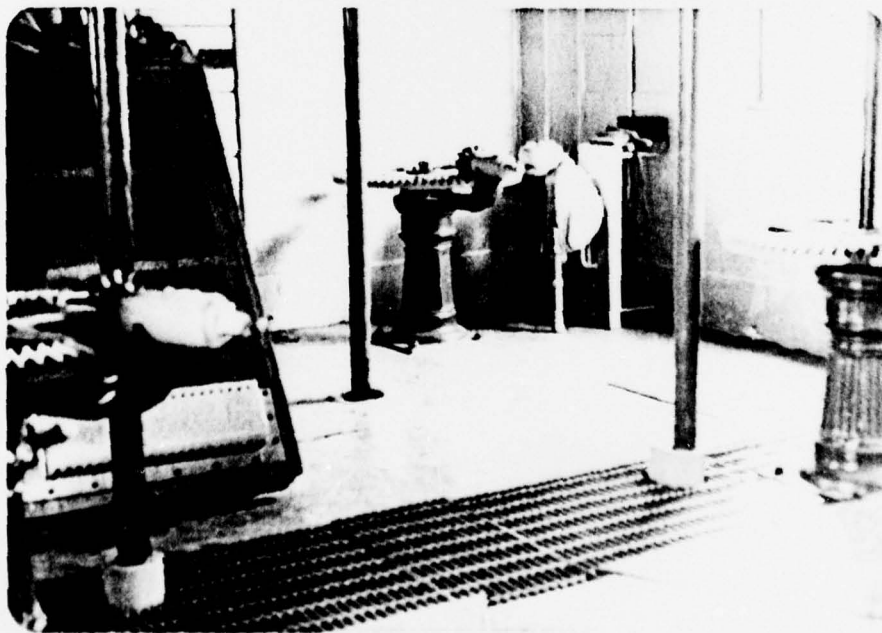
Photograph No. 3  
Primary spillway crest.



Photograph No. 4  
Side channel spillway crest.



Photograph No. 5  
Intake tower.



Photograph No. 6  
Valve controls in intake tower.





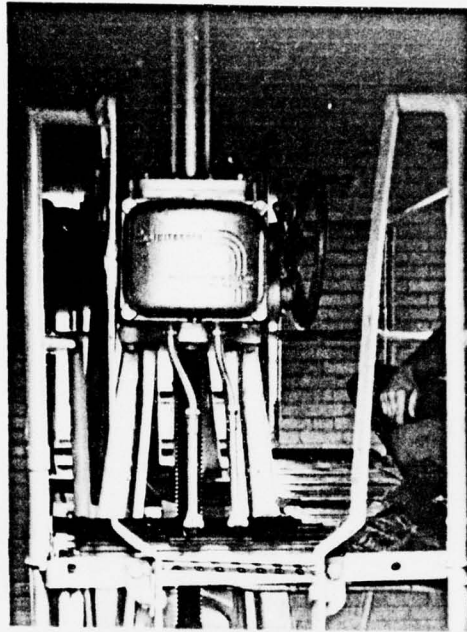
Photograph No. 7

Toe area (lake "blow-off" plunge pool; supply line "blow-off" valve house in background).



Photograph No. 8

Supply line "blow-off" operating.



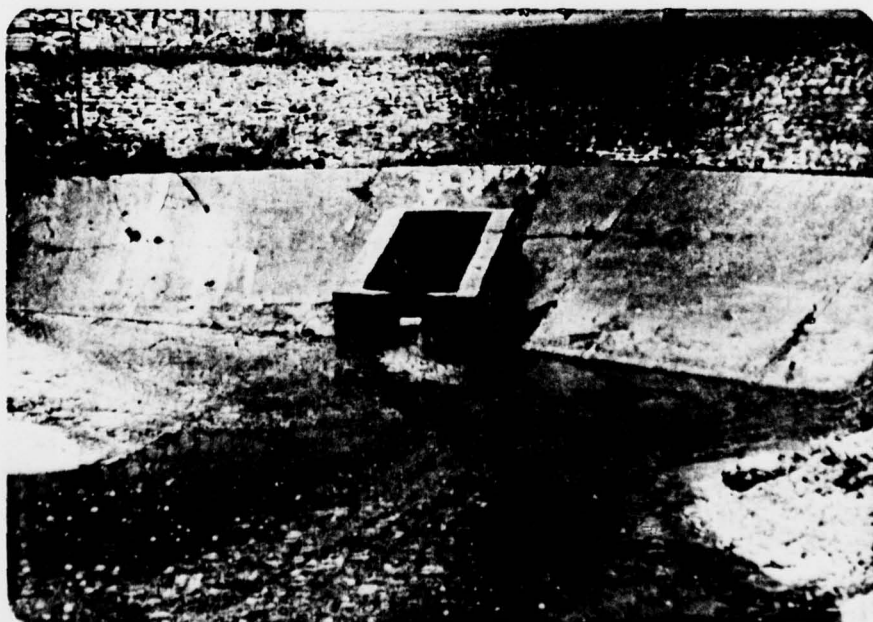
Photograph No. 9  
Supply line "blow-off" valve.



Photograph No. 10  
Spalling in spillway discharge channel.



Photograph No. 11  
Seepage weir on left abutment.



Photograph No. 12  
Seepage weir in lake "blow-off" plunge pool.



Photograph No. 13  
Bridge at Benson (looking east).



Photograph No. 14  
Bridge at Benson (looking west).



APPENDIX D  
CALCULATIONS

# IDAIPOLONIA

CONSULTING ENGINEERS, INC

By 1 Date 6/14/72 Subject QUEHAHONING RESERVOIR Sheet No. 1 of 2

Chkd. By ME Date 6/15/72 Hydrology & Hydraulics Proj. No. 73-14-27

DAM: QUEHAHONING DAM, NDS 2D #  
QUEHAHONING AND CONEMAUGH TOWNSHIPS, SOMERSET CO.,

WATERSHED AREA,  $A_1 = 94$  SQ. MI

INFLOW HYDROGRAPH: BASIN OHIO RIVER BASIN, QUEHAHONING CREEK OF STONY CREEK.

TOTAL TIME,  $T_1 = 86$  Hours

PMF PEAK FLOW,  $q = 680$  cfs/SQ MILE

PMF PEAK FLOW,  $Q = q A = 680 \times 94 = \boxed{63920 \text{ cfs}}$

VOLUME OF INFLOW HYDROGRAPH

$$\begin{aligned} V_1 &= \frac{1}{2} T \times 3600 \times Q \times \frac{1}{42560} \text{ AC-FT} \\ &= \frac{1}{2} (86) (3600) (63920) \left( \frac{1}{42560} \right) \\ &= 227,154 \text{ AC-FT} \text{ EQUAL TO } 45.3" \text{ RUNOFF} \end{aligned}$$

REDUCED TO 26 IN RUNOFF IN 49.3 hour

Spillway capacity  $V_1 = \frac{26}{12} \times 94 \times 640 = 130347 \text{ ac-ft}$   
Say 130400 ac-ft

TYPE: OGEE SPILLWAY; L-SHAPED W/SIDE DELIVERY CHAIN (

LENGTH: 210 (NEW) + 185 (EXISTING) = 395 ft

DESIGN DISCHARGE RATE = 23600 cfs (NEW) + 21400 cfs (EX.)  
= 45000 cfs

Design Max. Elevation 1636.4  $\Delta H = 1636.4 - 1627$   
= 9.4 FT

discharge coef =  $C = \frac{45000}{(395)(9.4)^{1.5}} = 3.95 \text{ OK}$

MAX DISCHARGE =  $(3.95)(395)(15)^{1.5} \approx 91000 \text{ cfs}$

FOR PMF DISCHARGE, Head Req'd  $h$ , (WITHOUT CONSIDER STORAGE)

$$h = \left[ \frac{63920}{(3.95)(395)} \right]^{1/1.5} = 11.88 \text{ FT} < 15 \text{ FT}$$

OK

# IDAIPOLONIA

CONSULTING ENGINEERS, INC

By TC Date 6-14-78 Subject QUENAHONING RESERVOIR

Sheet No. 2 of 2

Chkd. By MB Date 6/15/78 HYDROLOGY & HYDRAULIC

Proj. No. 73-14-07

## RESERVOIR STORAGE CAPACITY

By PERIMETER & USGS MAP

EL	IN2	AREA
1625	9.2	845
1640	13.8	1267

$$\Delta V = \frac{15}{3} (845 + 1267 + \sqrt{1267 \times 845})$$

$$= 15734 \text{ ac-ft} / 15'$$

ASSUME UNIFORM BETWEEN ELEVATIONS

$$\Delta V = \frac{15734}{15} = 1049 \text{ ac-ft} / 15'$$

For PMF MAX WATER LEVEL (CONSIDER STORAGE)

$$\frac{\text{MAX SPILLWAY CAPACITY}}{\text{PEAK INFLOW}} + \frac{\text{STORAGE CAPACITY}}{\text{INFLOW VOLUME}} = 1$$

$$\frac{(3.95)(3.95)(h)^{1.5}}{63920} + \frac{1049 \times h}{130400} = 1$$

SOLVE FOR h  $h = 11.16 \text{ FT}$  Say  $h = 11.2$

OR MAX WATER LEVEL EL 1638.2

IT HAS A WAVE FREE BOARD OF 3.8 FT (DAMcrest EL 1642)

Spillway DISCHARGE RATE @ PMF

$$Q = (3.95)(3.95)(11.16)^{1.5} = 58185 \text{ cfs}$$

$$V_c = \frac{58185}{(3.95)(11.16)} \approx 13.2 \text{ fps @ O/S SECTION}$$

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APPENDIX E  
REGIONAL GEOLOGY



## APPENDIX E REGIONAL GEOLOGY

The Quemahoning Dam and reservoir lie in the Boswell Anticline, a north-northeast trending structure. The rock strata underlying the dam and reservoir consist of the Allegheny Group (Pennsylvanian Age). The rock consists of gray sandstones and shales with at least seven minable coal seams, many of which are being strip mined in the watershed of the dam. The dam and reservoir may be underlain by minable coal seams; however, there is no evidence that these seams have been mined. The underlying Pottsville Group, which is composed primarily of massive sandstones, is exposed just west of the reservoir along Quemahoning Creek. The rock type and steepness in the slopes surrounding the reservoir appear to preclude massive slides from occurring.